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VOL. VII

1. NEW MYXOPHYCEAE FROM PORTO RICO—BY NATHANIEL LYON GARDNER.
2. THE FLOWER BEHAVIOR OF AVOCADOS—BY A. B. STOUT.
3. DESCRIPTIONS OF NEW GENERA AND SPECIES OF PLANTS COLLECTED ON THE MULFORD BIOLOGICAL EXPLORATION OF THE AMAZON VALLEY, 1921–1922—BY H. H. RUSBY.
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By ARTHUR HOLLICK

New York
1927

PREFACE

Of the four papers contained in Volume VII of the Memoirs of The New York Botanical Garden, the two longest, the first and the third, have been provided with individual indices. It is hoped that the tables of contents that introduce the two shorter papers will, in a large measure, take the place of separate indices for those contributions.

The editor gratefully acknowledges the assistance of Dr. John Hendley Barnhart and the cordial cooperation of the four authors.

MARSHALL A. HOWE,
Editor.

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NEW MYXOPHYCEAE FROM PORTO RICO

Nathaniel Lyon Gardner

(with plates 1–23)

Introduction

The new species of Myxophyceae proposed in this paper are based almost wholly upon material collected by Dr. N. Wille on the Island of Porto Rico during a three months' collecting trip extending from December 23, 1914, to March 24, 1915. The enterprise was undertaken by Dr. Wille upon the invitation of Dr. N. L. Britton and carried through under Dr. Britton's direction in the interest of The New York Botanical Garden. The account contains no marine species, since Dr. Wille's commission was to collect only fresh-water forms. This he seems to have done with unusual thoroughness, having assembled in his comparatively brief sojourn over two thousand specimens, furnishing each with data as to time, habitat, and locality. The collections included Chlorophyceae and Myxophyceae, with a few simple Rhodophyceae, assembled from almost every conceivable habitat. Stone bridges, old fences, and the walls of various old forts and buildings were found to be favorite habitats. Pools, ponds, quiet and swiftly running streams, and numerous hot springs furnished abundance of both Chlorophyceae and Myxophyceae. Terrestrial species occur frequently in the list. Arboreal forms seem to abound everywhere. Interesting mixtures were frequently taken from rock ledges, especially of limestone. There seems scarcely to have been a habitat which Dr. Wille overlooked and which did not yield a profitable supply of some one or more forms. Species of both the Green and the Blue-Green groups occur abundantly as the gonidia of very small and simple lichens.

One of the prominent features of the algal flora of the island is the interminable mixtures in which they abound. Scarcely a single collection which came to my notice consists of a pure single species. The multiplicity of intermingled forms made their determination oftentimes very difficult, especially so

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among nearly related unicellular forms. In many instances, intermediate or connecting forms, both unicellular and filamentous, occurred, leaving little choice as to the genus with which they should be associated. Some four hundred numbers contained specimens, ranging from a few scattered filaments to almost pure material, of *Scytonema.* Many were troublesome to place and I have created several new species. Many genera of Myxophyceae are very much in need of thorough revision. In several instances I am employing established genera as conveniences rather than as generic entities, and am not making an attempt at revision except in a few instances of modification mentioned in the text.

After the death of Dr. Wille I was invited by Dr. M. A. Howe to study the collection. I am proposing in this paper three new genera and two hundred and fourteen new species and varieties. Aside from these, I have identified over fifty species previously described. These comprise in all fifty different genera, probably by far the largest number of genera ever previously assembled from any equal area on the globe. The types are in possession of The New York Botanical Garden.

Synechocystis primigenia sp. nov.

PLATE 1, FIGURE 1

Cells perfectly spherical in the resting stage, without visible membrane or gelatinous tegument, 0.8–1 µ diam., pale aeruginous.

Growing on limestone between Hatillo and Arecibo, *no. 1377 b,* type; on the wall of a church, forming, in company with other Myxophyceae, a thin stratum, Sabana Grande, *no. 953 b.*

This is the smallest and simplest example of all the known species of the genus.

Synechocystis Willei sp. nov.

PLATE 1, FIGURE 2

Cells floating or free among other algae, not forming a stratum alone, spherical, 3.5–3.8 µ diam., homogeneous, pale aeruginous.

Growing in a pool about four kilometers north of Mayagüez, *no. 1329 b,* type.

Synechococcus intermedius sp. nov.

PLATE 1, FIGURE 3

Cells free, not aggregated into a stratum, narrowly cylindrical, 6–7 μ diam., 12–14 μ long, bright aeruginous, homogeneous, very thin-walled.

Growing on the bark of trees, Caguas, *no. 439 b,* type; on old leaves in a stream west of Humacao, *nos. 581 a* and *602*; east of Humacao, *no. 640*; on bark near Guanica, *no. 1841 c.*

Dactylococcopsis arcuata sp. nov.

PLATE 1, FIGURE 4

Cells 45–55 μ long, 1.4–1.8 μ diam., gently arcuate, free; wall very thin, contents homogeneous, yellowish green.

Growing among other Myxophyceae on the bark of a tree trunk, Caguas, *no. 439 e,* type.

The specimens of this species are very sparse, but seem unmistakably to be distinct, and apparently closely related to *D. acicularis* Lemmerm., from which it differs in being shorter, narrower, curved, and free from refringent granules.

Chroothece Willei sp. nov.

PLATE 1, FIGURE 5

Cells cylindrical, straight or more or less curved, with rounded ends, pale aeruginous to slightly yellowish, without tegument 5.8–6.2 μ diam., 18–22 μ long; tegument 8–10 μ thick, hyaline, homogeneous.

Growing in small clusters among other Myxophyceae, on limestone, Hato Arriba, Arecibo, *no. 1410,* type.

This is a very distinct species with relatively long and narrow cells, many of which are more or less curved. Unfortunately, the material is not abundant, as shown by its sparsity in the previously mentioned collection, the only one in which it was found.

Merismopedia Willei sp. nov.

PLATE 1, FIGURE 6

Families composed of 256–560 cells; membrane more or less distorted, 6.5–7.5 μ thick; cells subcylindrical in surface view just previous to cell division, 4.5–6 μ by 7.6 μ, nearly spherical in resting condition.

Growing in a pool about four kilometers north of Mayagüez, *no. 1310 a,* type.

This species of *Merismopedia* is to be distinguished from others by the combination of relatively large colonies containing relatively large cells.

Aphanocapsa intertexta sp. nov.

Plate 1, figure 7

Cells spherical, 2.4–2.6 μ diam., forming spherical colonies when young, more or less irregular in form and later coalescing to a considerable extent, not forming a definite stratum alone; pale aeruginous; entangled within the meshes of other small filamentous Myxophyceae or forming a thin stratum on large filamentous Myxophyceae.

Growing in association with several other species of Myxophyceae, especially filamentous forms, on rocks in Arroyo de los Corchos, *no. 1718,* type; on the filaments of *Stigonema scytonematoides* on red-colored earth by a road north of Maricao, no. *1250 a*; west of Humacao, *no. 573 b.*

Aphanocapsa Richteriana **major** var. nov.

Plate 1, figure 9

Cells 3.6–4.5 μ diam., aggregated into very irregular, but definite colonies 2–3 mm. diam., elongating previous to division, pale aeruginous to greenish gray; tegument firm, honey-colored, more nearly hyaline on the interior, the tegument persisting on the surface of the colony around single cells or groups of 2–4, but not showing on the interior of the colony.

Growing on soil in the primeval forest by Hacienda Catalina, Palmer, *no. 754 a,* type.

On the surface of the colonies of this species of *Aphanocapsa* the teguments persist and are plainly visible through two to three generations of cells before merging into the community tegument. That part of the colony resembles the genus *Gloeothece,* but on the interior of the colony there is no trace of the individual tegument.

The cells are rarely, if ever, two times as long as broad, but are longer on the surface of the colony than in its interior, where they are spherical.

Aphanothece opalescens sp. nov.

PLATE 1, FIGURE 8

Colonies irregular in outline, more or less nodular, subgelatinous, up to 200 μ diam.; cells 1–1.4 μ diam., 2–2.4 times as long as the diam., yellowish green; colonial tegument opalescent, moderately firm, ample, the individual teguments around each cell or small group of cells remaining distinct and visible for some time, giving to the colony the appearance of a pile of fused spheres; the individual sheaths ample, not lamellose.

Growing intermixed with other species of Myxophyceae, at La Chiquita near Maricao, *no. 1144 e,* type, collected by Dr. N. L. Britton.

Aphanothece bacilloidea sp. nov.

PLATE 1, FIGURE 10

Cells aggregated into microscopic masses, indefinite in shape and size, not forming a definite stratum, short, cylindrical, 0.8–1 μ diam., about 2 times as long as the diameter.

Growing in depressions in limestone at Hato Arriba, Arecibo, *no. 1407 a,* type; in depressions in limestone between Hatillo and Arecibo, *no. 1378*; among other Myxophyceae in an underground passage in Fort San Cristobal, San Juan, *no. 1989 c.*

APHANOTHECE CONFERTA **brevis** var. nov.

Cells 3.5 μ diam., 4.5–5 μ long, when in rapid division subspherical, otherwise as the species.

Growing on a water pipe by a stream, near Maricao, *no. 1147,* type; on rocks between Utuado and Adjuntas, *no. 1635 a.*

APHANOTHECE MICROSCOPICA **granulosa** var. nov.

PLATE 1, FIGURE 11

Colonies irregular in outline at maturity, up to 400 μ diam.; cells 4.5–5 μ diam., 7–8 μ long, densely granular, yellowish or honey-colored; tegument yellowish brown.

Growing on rocks at Penuelas, *no. 1848 a,* type.

Chroococcus cubicus sp. nov.

PLATE 1, FIGURE 12

Cells associated into families of 2–4, free among other algae, not forming a stratum alone; single cells with tegument 1.8–2.5 μ diam., spherical to somewhat irregular in outline, very pale aeruginous, homogeneous; families of 4 with tegument 6–7 μ diam., approximately cuboidal; tegument homogeneous, hyaline.

Growing in abundance among other species of Myxophyceae on a wooden fence, at Hotel Nava, Santurce, *no. 3,* type, and *nos. 2, 4a, 5, 142,* and *143 a.* It was also found growing on various kinds of rock and walls in the following numerous localities: San Juan, *nos. 66 a, 92 b, 1993 a, 1999, 2004 c, 2007, 2011* and *2021 c*; Rio Piedras, *no. 177*; Coamo Springs, *nos. 254 a, 307 a, 313, 402 b, 409 b;* Fajardo, *nos. 682 a, 713, 717 a, 734 a,* and *736 a*; Palermo, *no. 755*; Laguna Tortuguero, *nos. 871* and *872*; Sabana Grande, *no. 923 a*; Mayagüez, *no. 982 b*; Maricao, *nos. 1050, 1060 1061* and *1190*; Arecibo, *nos. 1337, 1363, 1368, 1372 b, 1457* and *1462*; Guanica, *nos. 1838* and *1841 a.*

This is an exceedingly diminutive, though distinct and well-marked, species of *Chroococcus.* The sheath, or tegument, is very thin and hyaline. Frequently only one of the cells in a colony of two divides, leaving the colony triangular.

Chroococcus subsphericus sp. nov.

Plate 2, figure 13

Families composed of 2–4 cells, free among other algae, spherical or subspherical, not forming a stratum alone; families of 4, 16–19 μ diam. with the tegument; single cells 8–10 μ diam. with tegument, 6–6.5 μ without tegument, purplish drab or gray; tegument hyaline, homogeneous.

Growing among other Myxophyceae on a wall by Hot Springs, Coamo Springs, *no. 402 a,* type, and *no. 403 a.*

The above-described species seems to be nearest related to *C. caldariorum* Hansg. There is much less variation in the size of the cells, and the color is not so intense, as has been attributed to that species.

Chroococcus mediocris sp. nov.

Plate 2, figure 14

Families composed of 2–4 cells, free, not forming a definite stratum alone; single cells spherical, bright aeruginous, finely granular; families of 4 very angular, 9–11.5 μ diam. without tegument, 15–18 μ diam. with the tegument; tegument hyaline, homogeneous, smooth.

Growing in association with numerous other species of algae in Laguna Tortuguero, *no. 831 h,* type.

The species described above has a near relative, so far as size is concerned, in *Chroococcus limneticus* Lemm. The colonies do not adhere into a stratum and the individual tegument is thinner and is homogeneous, and there is no tegument investing groups of cells and colonies as in *C. limneticus.* It is also closely related to *C. subsphericus* of this paper.

CHROOCOCCUS TURGIDUS **uniformis** var. nov.

Families of 4 up to 50 μ diam. with tegument; single cells with tegument 24–26 μ diam., without tegument 13–17 μ diam. (up to 25 μ) in the colony, bright aeruginous; tegument homogeneous, hyaline, 7–10 μ thick.

Growing among other species of algae on damp rocks, Coamo Springs, *no. 287 a,* type.

The variety is especially to be distinguished from the species by the complete absence of lamination of the tegument and by the larger size of the colonies.

Chroococcus muralis sp. nov.

PLATE 2, FIGURE 15

Families composed of 2–4 cells, closely aggregated, but not at all coalescent; families of four, 5–6.5 μ diam. with tegument; single cells 3.5–4 μ diam. with tegument, 1.5–2 μ diam. without tegument, spherical, pale aeruginous, obscured by the membranaceous, firm, smooth, homogeneous, purplish-violet tegument.

Growing on a wall, Coamo Springs, *no. 301,* type.

The species is to be distinguished from others by the small size of the cells and by the violet-colored tegument.

Chroococcus aeruginosus sp. nov.

PLATE 2, FIGURE 16

Families composed of 2–4 or more cells, spread out in a thin stratum among the filaments of other algae, and closely crowded together; families of four 8–10 μ diam.; single cells spherical, 3.8–4.8 μ diam. without tegument, bright aeruginous, homogeneous, decidedly angular in the family; tegument thin, hyaline, homogeneous.

Growing among the filaments of other Myxophyceae, principally *Phormidium,* on wood by Hot Springs, Coamo Springs, *no. 382 a,* type.

The cells are so closely crowded in the families, and the families are so close together it is difficult to state just how many cells constitute a family, probably never over eight.

CHROOCOCCUS GIGANTEUS **occidentalis** var. nov.

PLATE 2, FIGURE 17

Single cells spherical, 32–40 μ diam. without tegument, 60–75 μ diam. with tegument; families of 2–4, 80–100 μ diam. with tegument; tegument hyaline, homogeneous, 11–13 μ diam.

Growing in company with other Myxophyceae in Laguna Tortuguero, *no. 849 b,* type.

The variety differs from the species in being slightly larger, having a thicker tegument which is not lamellose.

Chroococcus minutissimus sp. nov.

PLATE 2, FIGURE 18

Cells associated into families of 2–4, free among other algae, not forming a stratum alone; single cells with tegument 1–1.5 μ diam., spherical, pale aeruginous, homogeneous; families of four with tegument 4.8–5.5 μ diam.; tegument exceedingly thin, almost invisible, hyaline.

Growing upon other algae in a waterfall between Arecibo and Utuado, *no. 1458 b,* type.

Chroococcus minutissimus is closely related to *C. cubicus* of this paper. It is smaller in all of its dimensions. It is to be distinguished especially by the almost complete absence of tegument.

Chroococcus constrictus sp. nov.

PLATE 2, FIGURE 19

Families composed of 2–4 cells, adhering more or less into a thin stratum, soon after division of a single free cell at times becoming deeply constricted between the cells, frequently separating completely before reaching the 4-celled stage; cells pale aeruginous, homogeneous, spherical in the one-celled stage, somewhat compressed and angular in the 2- or 4-celled stages; tegument thin, hyaline, homogeneous, firm and glutinous, single cells 7.5–9 μ diam. without tegument.

Growing in a water basin west of the Experiment Station, Rio Piedras, *no. 1965,* type.

This species of *Chroococcus* is to be distinguished from others by the deep constrictions which appear between the cells during and after division of the protoplast, frequently completely separating the two resulting cells before the second division appears.

Chroococcus heanogloios sp. nov.

Plate 2, figure 20

Cells homogeneous, olive-green, aggregated into small groups on the filaments of the host, associated into colonies of 2–4, spherical when existing singly, 8–10 μ diam., compressed and angular in colonies of 2 or 4; colonies of 4 with tegument 18–20 μ diam.; tegument hyaline, homogeneous, thin and apparently membranaceous but glutinous.

Growing more or less epiphytic on *Scytonema capitatum* on rocks about ten kilometers north of Utuado, *no. 1537 c,* type.

The unusual epiphytic habit, and the very thin, somewhat gelatinous tegument are characters distinguishing this species of *Chroococcus.*

Gloeocapsa cartilaginea sp. nov.

Plate 2, figure 21

Families adhering by their gelatinous walls forming a homogeneous, tough, cartilaginous stratum 2–2.3 mm. thick; cells spherical, pale aeruginous, 1.5–2.5 μ diam., forming families of 2–4, rarely more; families of four, 6–8 μ diam.; common teguments hyaline, cartilaginous, homogeneous; teguments of individual cells and small families soon becoming confluent, not lamellose.

Growing on red soil near Maricao, *no. 1025,* type.

Gloeocapsa cartilaginea **minor** var. nov.

Families of four 7.5–9.5 μ diam., cells 0.8–1.2 μ diam., forming stratum 2–3 mm. thick, individual teguments very distinct and opalescent, otherwise as the species.

Growing on limestone between Hatillo and Arecibo, *no. 1377,* type; near Hato Arriba, Arecibo, *no. 1428.*

Gloeocapsa acervata sp. nov.

PLATE 2, FIGURE 22

Families very variable as to the number of cells they contain as well as to their shape and size, having up to 256, probably even more cells, spherical to slightly elongated and lobular, piled together in heaps, adhering by their very soft, gelatinous walls and forming a continuous stratum; cells spherical, 0.9–1.3 µ diam., bright aeruginous, regularly arranged in the young families, or colonies, soon arranging themselves in no definite order in the older families; tegument hyaline or almost transparent in the younger colonies, changing to honey-color, or later to dark brown, homogeneous throughout the colony.

Growing on limestone between Hatillo and Arecibo, *no. 1390,* type, and *no. 1393*; near Hato Arriba, Arecibo, *no. 1425.*

It is questionable as to whether the above newly described organism should be considered as belonging to the genus *Gloeocapsa* or to the genus *Anacystis.* It is a borderline species. In its very youngest stages, it conforms to the *Gloeocapsa* method of development. The colonies of two, four, and eight are more or less angular, the cells are symmetrically arranged, and in some cases a slight stratification of the tegument may be seen. The colonies soon become spherical, the cells are promiscuously arranged, and with no indication of stratification of the tegument. They then resemble typical members of the genus *Anacystis.* Their teguments are sticky, and the growing colonies become agglutinated into masses with lobular surfaces, in this stage superficially resembling *Microcystis ichthyoblabe* Kuetz. There seems to be no especially visible modification of the cells to form resting spores at the end of the life cycle. The teguments finally seem to become completely confluent, and the cells, probably after a period of rest, begin actively to divide and new colonies are formed in position. This seems to be a typical *Gloeocapsa* characteristic, and for this reason I have placed the material under that genus.

GLOEOCAPSA LIVIDA **minor** var. nov.

PLATE 2, FIGURE 23

Families composed of 2 (rarely more) cells, more or less agglutinated into small groups, forming with other algae, a more or less continuous stratum; cells 3 μ diam. without the tegument, spherical, bright aeruginous, 7–8 μ diam. with tegument, homogeneous; tegument hyaline, homogeneous, the younger teguments more dense than the older.

Growing in close association with certain species of filamentous Myxophyceae on limestone near Hato Arriba, Arecibo, *no. 1406 a,* type, and *no. 1397 a.*

The collection of *Gloeocapsa* mentioned above seems very close to *G. livida* (Carmich.) Kuetz., judging from the descriptions and illustrations of Kuetzing, Hassall, and Meneghini. In its present state of development the cells, in a large part, gravitate from each other after each division, but remain within the same colonial tegument. Generally they are to be found in groups of four. Certain other colonies may contain as many as sixteen cells before disintegration of their teguments. In the description of *G. livida* it is stated that the families contain "16–24 cells."

Gloeocapsa calcicola sp. nov.

PLATE 2, FIGURE 24

Cells associated into families of 2–4 or rarely 8, spherical to slightly elongated before division, 1.1–1.3 μ diam. without tegument, pale aeruginous, homogeneous; families of four, 10–12 μ diam. with tegument, cuboidal, with rounded corners; tegument hyaline, faintly lamellose.

Growing on limestone at Hacienda, Laguna Tortuguero, *no. 866,* type; on a wall in company with other species of Myxophyceae, together forming a thin, dark stratum at the Hotel Nava, Santurce, *no. 55 a.*

This is one among the most diminutive species of the genus. It is very closely related to certain species of the genus *Chroococcus,* and it is difficult to state the distinguishing characteristics of such border-line organisms. This is particularly true of the material of *no. 55 a,* which is not absolutely identical with the type, *no. 866,* but too close to be separated specifically.

Gloeocapsa ovalis sp. nov.

PLATE 2, FIGURE 25

Cells adhering into small families, rarely containing more than 4 cells, associated with other species of algae forming a thin dark stratum on rocks, 5.8–6.2 μ diam. without the tegument, 9–12 μ diam. with the tegument, spherical when alone, remaining angular for some time after division, bright aeruginous, homogeneous; families of two cells 12–14 μ long, broadly ellipsoidal, those of 4 cells 14–16 μ long; tegument hyaline, more or less lamellose on the family, homogeneous on the single cells.

Growing on limestone between Utuado and Adjuntas, *no. 1640,* type.

Gloeocapsa sphaerica sp. nov.

PLATE 3, FIGURE 26

Families spherical to irregular in outline, containing a variable number of cells, up to 128 before the dissolution of the general tegument, soft, subgelatinous, adhering to each other at times, forming masses microscopic in size; cells spherical to slightly elongated before division, yellowish green, 2–2.3 μ diam., usually separated from each other in the colony by 2–3 times their diam.; teguments homogeneous, opalescent, ample, smooth on the surface; teguments of individual cells arising soon after cell division, not persisting long, but merging into the colonial tegument.

Growing on limestone between Arecibo and Utuado, *no. 1482 a,* type.

The distinguishing feature of this species of *Gloeocapsa* is the perfectly spherical form of the young colonies with an ample, homogeneous, opalescent tegument, and not a more or less angular colony, as is the case in most species of the genus in the juvenile stage. It seems closely related to *G. squamulosa* Bréb., which has a thick, hyaline tegument. It differs from that species in having the cells associated into much larger families, with a larger number of cells in the family.

GLOEOCAPSA QUATERNATA **major** var. nov.

PLATE 3, FIGURE 27

Families composed of 2, more rarely of 4, cells, broadly ellipsoidal, 13–15 μ long, closely crowded together but not confluent; cells 3.5–4.2 μ diam. and 6.7 μ long without tegument, homogeneous, aeruginous; tegument very distinctly lamellose, hyaline, becoming yellowish brown with age.

Growing on the wall of an old conservatory, San Juan, *no. 131 a,* type.

The variety is to be distinguished from the species in having larger and ellipsoidal colonies, in having elongated cells and in having yellowish-brown tegument on the surface of the stratum when aged. The cells are distinctly elongated, a character not, strictly speaking, that of a typical *Gloeocapsa,* but the cells divide in three planes, thus excluding it from the genus *Gloeothece.*

Gloeothece interspersa sp. nov.

Plate 3, figure 28

Families more or less ellipsoidal, small, interspersed in the interstices of filamentous algae and fungi, composed of 2–4 or rarely 8 cells; families of 2 cells 13–15 μ long, of 4 cells 16–18 μ long; single cell cylindrical, with rounded ends, 3.6–4 μ diam., 7–7.5 μ long without the tegument, pale aeruginous; tegument hyaline, relatively wide, lamellose.

Growing on a wall by the Hotel Nava, Santurce, *no. 54 a,* type.

Gloeothece endochromatica sp. nov.

Plate 3, figure 29

Colonies very small, 15–25 μ diam., containing 16–32 or more cells, spherical to more or less lobed; cells 0.9 to 1.2 μ diam., 1.5–2 times as long as the diam., pale aeruginous to yellowish green; colonial tegument hyaline or slightly opalescent; single cells, or groups of 2 or more, surrounded by a relatively firm, very distinctly delimited, thick, dark-violet tegument, but not lamellose; as the cells become aged the color disappears in part.

Growing among other species of Myxophyceae on limestone, between Arecibo and Utuado, *no. 1465 a,* type.

The above-described species of *Gloeothece* structurally is on the border between the genera *Anacystis* and *Gloeothece.* The special or individual teguments appear to be fused with the general colonial tegument at times, as it does in some species of *Anacystis* but apparently no resting spores are produced, at least none could be found in the material under the stage of development in which it was found. It is also very closely related to certain species of *Gloeocapsa* of the *Cyanocapsa* section, but the presence of cylindrical cells which seem to divide in but one plane and then rotate within the colony before the next division would ally it with the genus *Gloeothece.*

Gloeothece parvula sp. nov.

PLATE 3, FIGURE 30

Families containing up to 32 cells, but usually 8–16, free or collected into small masses among other algae, not forming a definite stratum alone, 12–18 µ diam.; cells cylindrical, 1.2–1.5 µ diam., 2–3 times as long as the diam., pale aeruginous; tegument hyaline, homogeneous, ample, 3–4 times as thick as the diameter of the lumen of the cell.

Growing in association with numerous other species of Myxophyceae, near Hato Arriba, Arecibo, *no. 1410 b,* type.

The above-described species of *Gloeothece* is apparently a near relative of *G. confluens,* a species, as a rule, with only two cells in a colony.

Gloeothece opalothecata sp. nov.

PLATE 3, FIGURE 31

Colonies moderately firm and rigid, spherical, containing 2–4 cells, agglutinated into masses of indefinite extent; cells slightly elongated, 2–2.5 µ diam., 1.25–2 times as long as broad without the tegument; tegument opalescent, homogeneous, firm, about 3 times as thick as the lumen of the cell.

Growing on limestone, near Hato Arriba, Arecibo, no *1434,* type.

This species is on the border line between *Gloeothece* and *Gloeocapsa.* The cells in a state of division are mostly spherical, but when in the resting stage they average about one-half longer than broad.

The colonies remain spherical even in large masses, the mutual pressure not being sufficient to distort them, the teguments being firm. They are sufficiently sticky on the surface, however, to cause them to adhere very firmly to each other. The species has a near relative in *Aphanothece opalescens* of this paper.

Gloeothece prototypa sp. nov.

PLATE 3, FIGURE 32

Families floating free, congregated into small masses, or forming a continuous stratum, composed of 2–4 cells, very abundantly existing as single cells, those of 4 cells 7–8 μ diam.; cells cylindrical, 0.8–1.2 μ diam., 2–3 μ long, pale aeruginous; tegument very nearly colorless, homogeneous, about equal in diam. to the cells.

Growing on limestone, between Hatillo and Arecibo, *no. 1377 a*, type, and *no. 1378 a*; on a water pipe near a stream, Maricao, *no. 1147 a*; on limestone at Hato Arriba, Arecibo, *no. 1407 b;* and between Arecibo and Utuado, *no. 1481 a.*

This is a very diminutive species of *Gloeothece,* when young appearing with but very little tegument, and that almost transparent. It finally develops a visible sheath or tegument, which combines 2–4 cells, very rarely more, into small families, where it has the typical *Gloeothece* character and resembles, to a less degree, certain Bacteria.

Anacystis gigas (W. & G. S. West) comb. nov.

Gloeocapsa gigas W. and G. S. West.[1]

Growing in company with other species of Myxophyceae on limestone, between Arecibo and Utuado, *no. 1476*; between Hatillo and Arecibo, *no. 1387 b*; on old wood at Hato Arriba, Arecibo, *no. 1397 b*; on a wall in Fort San Cristobal, San Juan, *nos. 1991 c, 1993, 2002, 2003 d, 2008, 2014 c* and *2021.*

A large percentage of the species of Myxophyceae collected by Dr. Wille on Porto Rico are unicellular. Many of these species belong and may readily be associated with more or less well-recognized and clearly defined genera. Others seem decidedly to be allied with less clearly delimited genera and before these can be satisfactorily placed the limits of such genera must be either more clearly defined and amplified or new genera must be erected for their reception. In this instance I shall attempt the former procedure. Three of such genera are *Chroococcus* Naegeli, *Gloeocapsa* Kuetzing, and *Anacystis* Meneghini.

Naegeli proposed the genus *Chroococcus* in 1849,[2] selecting as the type of the genus *C. rufescens* (*Pleurococcus rufescens* Bréb.) at the same time recognizing nine other previously described species, which had been placed with one or the other of the genera *Protococcus* or *Pleurococcus.* All of these have since been very generally recognized as belonging to *Chroococcus.*

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[1] On some fresh water algae from the West Indies. Jour. Linn. Soc. Bot. 30: 276. *pl. 16.* 1895.

[2] Gattungen einzelliger Algen, 44.

Naegeli's conception of the genus as set forth in his diagnosis and in his discussion which follows seems to have been of a group whose cells exist either singly or, by division "in allen Richtungen des Raumes" and remaining for a time intact, become associated into small, spherical or cuboidal families, or colonies of 2—8 or, more rarely, 16–32 cells, surrounded by a thin colorless, homogeneous or at times slightly lamellose wall. Although Naegeli states that the wall is thin, scarcely one-third the thickness of the lumen of the cell (a thick wall as compared to the cell proper) he undoubtedly meant thin as compared to that of *Gloeocapsa,* which he discusses in connection with *Chroococcus,* and which may become several times thicker than the lumen of the cell.

The genus *Gloeocapsa* was proposed by Kuetzing in 1843.[3] He designated no type species, but the first species mentioned is *G. montana,* which may ordinarily be considered the type of a genus when no special one is proposed. His diagnosis of the genus is very brief and incomplete. In 1846,[4] he illustrated the species.

The genus was reviewed by Naegeli (*loc. cit.*), who designated as the type *G. atrata* Kuetz., which he redescribed and illustrated. I have examined bits of the type of both of these species and judging from these and from the descriptions and figures given by Kuetzing and Naegeli, both writers had practically the same conception so far as the type, *G. atrata,* is concerned. As pointed out by Naegeli and by subsequent writers, the two genera *Chroococcus* and *Gloeocapsa* undoubtedly overlap, and such forms as *G. montana* seem as clearly allied to the one as to the other. I am considering forms with a firm, smooth, hyaline wall, or tegument, with relatively few cells in a colony, and these remaining angular after division throughout the greater part of the life cycle of the colony, and such forms as remain within special teguments for several generations all remaining within a common, more or less gelatinous, original,

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[3] Phycologia Generalis.

[4] Tabulae Phycologicae, **1**: *pl. 19. f. III.*

NEW MYXOPHYCEAE FROM PORTO RICO

Nathaniel Lyon Gardner

(with plates 1–23)

Introduction

The new species of Myxophyceae proposed in this paper are based almost wholly upon material collected by Dr. N. Wille on the Island of Porto Rico during a three months' collecting trip extending from December 23, 1914, to March 24, 1915. The enterprise was undertaken by Dr. Wille upon the invitation of Dr. N. L. Britton and carried through under Dr. Britton's direction in the interest of The New York Botanical Garden. The account contains no marine species, since Dr. Wille's commission was to collect only fresh-water forms. This he seems to have done with unusual thoroughness, having assembled in his comparatively brief sojourn over two thousand specimens, furnishing each with data as to time, habitat, and locality. The collections included Chlorophyceae and Myxophyceae, with a few simple Rhodophyceae, assembled from almost every conceivable habitat. Stone bridges, old fences, and the walls of various old forts and buildings were found to be favorite habitats. Pools, ponds, quiet and swiftly running streams, and numerous hot springs furnished abundance of both Chlorophyceae and Myxophyceae. Terrestrial species occur frequently in the list. Arboreal forms seem to abound everywhere. Interesting mixtures were frequently taken from rock ledges, especially of limestone. There seems scarcely to have been a habitat which Dr. Wille overlooked and which did not yield a profitable supply of some one or more forms. Species of both the Green and the Blue-Green groups occur abundantly as the gonidia of very small and simple lichens.

One of the prominent features of the algal flora of the island is the interminable mixtures in which they abound. Scarcely a single collection which came to my notice consists of a pure single species. The multiplicity of intermingled forms made their determination oftentimes very difficult, especially so among nearly related unicellular forms. In many instances, intermediate or connecting forms, both unicellular and filamentous, occurred, leaving little choice as to the genus with which they should be associated. Some four hundred numbers contained specimens, ranging from a few scattered filaments to almost pure material, of *Scytonema*. Many were troublesome to place and I have created several new species. Many genera of Myxophyceae are very much in need of thorough revision. In several instances I am employing established genera as conveniences rather than as generic entities, and am not making an attempt at revision except in a few instances of modification mentioned in the text.

After the death of Dr. Wille I was invited by Dr. M. A. Howe to study the collection. I am proposing in this paper three new genera and two hundred and fourteen new species and varieties. Aside from these, I have identified over fifty species previously described. These comprise in all fifty different genera, probably by far the largest number of genera ever previously assembled from any equal area on the globe. The types are in possession of The New York Botanical Garden.

Synechocystis primigenia sp. nov.

PLATE 1, FIGURE 1

Cells perfectly spherical in the resting stage, without visible membrane or gelatinous tegument, 0.8–1 μ diam., pale aeruginous.

Growing on limestone between Hatillo and Arecibo, *no. 1377 b,* type; on the wall of a church, forming, in company with other Myxophyceae, a thin stratum, Sabana Grande, *no. 953 b.*

This is the smallest and simplest example of all the known species of the genus.

Synechocystis Willei sp. nov.

PLATE 1, FIGURE 2

Cells floating or free among other algae, not forming a stratum alone, spherical, 3.5–3.8 μ diam., homogeneous, pale aeruginous.

Growing in a pool about four kilometers north of Mayagüez, *no. 1329 b,* type.

Synechococcus intermedius sp. nov.

Plate 1, figure 3

Cells free, not aggregated into a stratum, narrowly cylindrical, 6–7 μ diam., 12–14 μ long, bright aeruginous, homogeneous, very thin-walled.

Growing on the bark of trees, Caguas, *no. 439 b,* type; on old leaves in a stream west of Humacao, *nos. 581 a* and *602*; east of Humacao, *no. 640*; on bark near Guanica, *no. 1841 c.*

Dactylococcopsis arcuata sp. nov.

Plate 1, figure 4

Cells 45–55 μ long, 1.4–1.8 μ diam., gently arcuate, free; wall very thin, contents homogeneous, yellowish green.

Growing among other Myxophyceae on the bark of a tree trunk, Caguas, *no. 439 e,* type.

The specimens of this species are very sparse, but seem unmistakably to be distinct, and apparently closely related to *D. acicularis* Lemmerm., from which it differs in being shorter, narrower, curved, and free from refringent granules.

Chroothece Willei sp. nov.

Plate 1, figure 5

Cells cylindrical, straight or more or less curved, with rounded ends, pale aeruginous to slightly yellowish, without tegument 5.8–6.2 μ diam., 18–22 μ long; tegument 8–10 μ thick, hyaline, homogeneous.

Growing in small clusters among other Myxophyceae, on limestone, Hato Arriba, Arecibo, *no. 1410,* type.

This is a very distinct species with relatively long and narrow cells, many of which are more or less curved. Unfortunately, the material is not abundant, as shown by its sparsity in the previously mentioned collection, the only one in which it was found.

Merismopedia Willei sp. nov.

Plate 1, figure 6

Families composed of 256–560 cells; membrane more or less distorted, 6.5–7.5 μ thick; cells subcylindrical in surface view just previous to cell division, 4.5–6 μ by 7.6 μ, nearly spherical in resting condition.

Growing in a pool about four kilometers north of Mayagüez, *no. 1310 a,* type.

This species of *Merismopedia* is to be distinguished from others by the combination of relatively large colonies containing relatively large cells.

Aphanocapsa intertexta sp. nov.

PLATE 1, FIGURE 7

Cells spherical, 2.4–2.6 μ diam., forming spherical colonies when young, more or less irregular in form and later coalescing to a considerable extent, not forming a definite stratum alone; pale aeruginous; entangled within the meshes of other small filamentous Myxophyceae or forming a thin stratum on large filamentous Myxophyceae.

Growing in association with several other species of Myxophyceae, especially filamentous forms, on rocks in Arroyo de los Corchos, *no. 1718,* type; on the filaments of *Stigonema scytonematoides* on red-colored earth by a road north of Maricao, no. *1250 a*; west of Humacao, *no. 573 b.*

APHANOCAPSA RICHTERIANA **major** var. nov.

PLATE 1, FIGURE 9

Cells 3.6–4.5 μ diam., aggregated into very irregular, but definite colonies 2–3 mm. diam., elongating previous to division, pale aeruginous to greenish gray; tegument firm, honey-colored, more nearly hyaline on the interior, the tegument persisting on the surface of the colony around single cells or groups of 2–4, but not showing on the interior of the colony.

Growing on soil in the primeval forest by Hacienda Catalina, Palmer, *no. 754 a,* type.

On the surface of the colonies of this species of *Aphanocapsa* the teguments persist and are plainly visible through two to three generations of cells before merging into the community tegument. That part of the colony resembles the genus *Gloeothece,* but on the interior of the colony there is no trace of the individual tegument.

The cells are rarely, if ever, two times as long as broad, but are longer on the surface of the colony than in its interior, where they are spherical.

Aphanothece opalescens sp. nov.

PLATE 1, FIGURE 8

Colonies irregular in outline, more or less nodular, subgelatinous, up to 200 μ diam.; cells 1–1.4 μ diam., 2–2.4 times as long as the diam., yellowish green; colonial tegument opalescent, moderately firm, ample, the individual teguments around each cell or small group of cells remaining distinct and visible for some time, giving to the colony the appearance of a pile of fused spheres; the individual sheaths ample, not lamellose.

Growing intermixed with other species of Myxophyceae, at La Chiquita near Maricao, *no. 1144 e,* type, collected by Dr. N. L. Britton.

Aphanothece bacilloidea sp. nov.

PLATE 1, FIGURE 10

Cells aggregated into microscopic masses, indefinite in shape and size, not forming a definite stratum, short, cylindrical, 0.8–1 μ diam., about 2 times as long as the diameter.

Growing in depressions in limestone at Hato Arriba, Arecibo, *no. 1407 a,* type; in depressions in limestone between Hatillo and Arecibo, *no. 1378*; among other Myxophyceae in an underground passage in Fort San Cristobal, San Juan, *no. 1989 c.*

APHANOTHECE CONFERTA **brevis** var. nov.

Cells 3.5 μ diam., 4.5–5 μ long, when in rapid division subspherical, otherwise as the species.

Growing on a water pipe by a stream, near Maricao, *no. 1147,* type; on rocks between Utuado and Adjuntas, *no. 1635 a.*

APHANOTHECE MICROSCOPICA **granulosa** var. nov.

PLATE 1, FIGURE 11

Colonies irregular in outline at maturity, up to 400 μ diam.; cells 4.5–5 μ diam., 7–8 μ long, densely granular, yellowish or honey-colored; tegument yellowish brown.

Growing on rocks at Penuelas, *no. 1848 a,* type.

Chroococcus cubicus sp. nov.

PLATE 1, FIGURE 12

Cells associated into families of 2–4, free among other algae, not forming a stratum alone; single cells with tegument 1.8–2.5 μ diam., spherical to somewhat irregular in outline, very pale aeruginous, homogeneous; families of 4 with tegument 6–7 μ diam., approximately cuboidal; tegument homogeneous, hyaline.

Growing in abundance among other species of Myxophyceae on a wooden fence, at Hotel Nava, Santurce, *no. 3,* type, and *nos. 2, 4a, 5, 142,* and *143 a.* It was also found growing on various kinds of rock and walls in the following numerous localities: San Juan, *nos. 66 a, 92 b, 1993 a, 1999, 2004 c, 2007, 2011* and *2021 c*; Rio Piedras, *no. 177*; Coamo Springs, *nos. 254 a, 307 a, 313, 402 b, 409 b;* Fajardo, *nos. 682 a, 713, 717 a, 734 a,* and *736 a*; Palermo, *no. 755*; Laguna Tortuguero, *nos. 871* and *872*; Sabana Grande, *no. 923 a*; Mayagüez, *no. 982 b*; Maricao, *nos. 1050, 1060 1061* and *1190*; Arecibo, *nos. 1337, 1363, 1368, 1372 b, 1457* and *1462*; Guanica, *nos. 1838* and *1841 a.*

This is an exceedingly diminutive, though distinct and well-marked, species of *Chroococcus.* The sheath, or tegument, is very thin and hyaline. Frequently only one of the cells in a colony of two divides, leaving the colony triangular.

Chroococcus subsphericus sp. nov.

PLATE 2, FIGURE 13

Families composed of 2–4 cells, free among other algae, spherical or subspherical, not forming a stratum alone; families of 4, 16–19 μ diam. with the tegument; single cells 8–10 μ diam. with tegument, 6–6.5 μ without tegument, purplish drab or gray; tegument hyaline, homogeneous.

Growing among other Myxophyceae on a wall by Hot Springs, Coamo Springs, *no. 402 a,* type, and *no. 403 a.*

The above-described species seems to be nearest related to *C. caldariorum* Hansg. There is much less variation in the size of the cells, and the color is not so intense, as has been attributed to that species.

Chroococcus mediocris sp. nov.

PLATE 2, FIGURE 14

Families composed of 2–4 cells, free, not forming a definite stratum alone; single cells spherical, bright aeruginous, finely granular; families of 4 very angular, 9–11.5 μ diam. without tegument, 15–18 μ diam. with the tegument; tegument hyaline, homogeneous, smooth.

Growing in association with numerous other species of algae in Laguna Tortuguero, *no. 831 h,* type.

The species described above has a near relative, so far as size is concerned, in *Chroococcus limneticus* Lemm. The colonies do not adhere into a stratum and the individual tegument is thinner and is homogeneous, and there is no tegument investing groups of cells and colonies as in *C. limneticus*. It is also closely related to *C. subsphericus* of this paper.

CHROOCOCCUS TURGIDUS **uniformis** var. nov.

Families of 4 up to 50 μ diam. with tegument; single cells with tegument 24–26 μ diam., without tegument 13–17 μ diam. (up to 25 μ) in the colony, bright aeruginous; tegument homogeneous, hyaline, 7–10 μ thick.

Growing among other species of algae on damp rocks, Coamo Springs, *no. 287 a,* type.

The variety is especially to be distinguished from the species by the complete absence of lamination of the tegument and by the larger size of the colonies.

Chroococcus muralis sp. nov.

PLATE 2, FIGURE 15

Families composed of 2–4 cells, closely aggregated, but not at all coalescent; families of four, 5–6.5 μ diam. with tegument; single cells 3.5–4 μ diam. with tegument, 1.5–2 μ diam. without tegument, spherical, pale aeruginous, obscured by the membranaceous, firm, smooth, homogeneous, purplish-violet tegument.

Growing on a wall, Coamo Springs, *no. 301,* type.

The species is to be distinguished from others by the small size of the cells and by the violet-colored tegument.

Chroococcus aeruginosus sp. nov.

PLATE 2, FIGURE 16

Families composed of 2–4 or more cells, spread out in a thin stratum among the filaments of other algae, and closely crowded together; families of four 8–10 μ diam.; single cells spherical, 3.8–4.8 μ diam. without tegument, bright aeruginous, homogeneous, decidedly angular in the family; tegument thin, hyaline, homogeneous.

Growing among the filaments of other Myxophyceae, principally *Phormidium,* on wood by Hot Springs, Coamo Springs, *no. 382 a,* type.

The cells are so closely crowded in the families, and the families are so close together it is difficult to state just how many cells constitute a family, probably never over eight.

CHROOCOCCUS GIGANTEUS **occidentalis** var. nov.

PLATE 2, FIGURE 17

Single cells spherical, 32–40 μ diam. without tegument, 60–75 μ diam. with tegument; families of 2–4, 80–100 μ diam. with tegument; tegument hyaline, homogeneous, 11–13 μ diam.

Growing in company with other Myxophyceae in Laguna Tortuguero, *no. 849 b,* type.

The variety differs from the species in being slightly larger, having a thicker tegument which is not lamellose.

Chroococcus minutissimus sp. nov.

PLATE 2, FIGURE 18

Cells associated into families of 2–4, free among other algae, not forming a stratum alone; single cells with tegument 1–1.5 μ diam., spherical, pale aeruginous, homogeneous; families of four with tegument 4.8–5.5 μ diam.; tegument exceedingly thin, almost invisible, hyaline.

Growing upon other algae in a waterfall between Arecibo and Utuado, *no. 1458 b,* type.

Chroococcus minutissimus is closely related to *C. cubicus* of this paper. It is smaller in all of its dimensions. It is to be distinguished especially by the almost complete absence of tegument.

Chroococcus constrictus sp. nov.

PLATE 2, FIGURE 19

Families composed of 2–4 cells, adhering more or less into a thin stratum, soon after division of a single free cell at times becoming deeply constricted between the cells, frequently separating completely before reaching the 4-celled stage; cells pale aeruginous, homogeneous, spherical in the one-celled stage, somewhat compressed and angular in the 2- or 4-celled stages; tegument thin, hyaline, homogeneous, firm and glutinous, single cells 7.5–9 μ diam. without tegument.

Growing in a water basin west of the Experiment Station, Rio Piedras, *no. 1965,* type.

This species of *Chroococcus* is to be distinguished from others by the deep constrictions which appear between the cells during and after division of the protoplast, frequently completely separating the two resulting cells before the second division appears.

Chroococcus heanogloios sp. nov.

Plate 2, figure 20

Cells homogeneous, olive-green, aggregated into small groups on the filaments of the host, associated into colonies of 2–4, spherical when existing singly, 8–10 μ diam., compressed and angular in colonies of 2 or 4; colonies of 4 with tegument 18–20 μ diam.; tegument hyaline, homogeneous, thin and apparently membranaceous but glutinous.

Growing more or less epiphytic on *Scytonema capitatum* on rocks about ten kilometers north of Utuado, *no. 1537 c,* type.

The unusual epiphytic habit, and the very thin, somewhat gelatinous tegument are characters distinguishing this species of *Chroococcus.*

Gloeocapsa cartilaginea sp. nov.

Plate 2, figure 21

Families adhering by their gelatinous walls forming a homogeneous, tough, cartilaginous stratum 2–2.3 mm. thick; cells spherical, pale aeruginous, 1.5–2.5 μ diam., forming families of 2–4, rarely more; families of four, 6–8 μ diam.; common teguments hyaline, cartilaginous, homogeneous; teguments of individual cells and small families soon becoming confluent, not lamellose.

Growing on red soil near Maricao, *no. 1025,* type.

GLOEOCAPSA CARTILAGINEA **minor** var. nov.

Families of four 7.5–9.5 μ diam., cells 0.8–1.2 μ diam., forming stratum 2–3 mm. thick, individual teguments very distinct and opalescent, otherwise as the species.

Growing on limestone between Hatillo and Arecibo, *no. 1377,* type; near Hato Arriba, Arecibo, *no. 1428.*

Gloeocapsa acervata sp. nov.

PLATE 2, FIGURE 22

Families very variable as to the number of cells they contain as well as to their shape and size, having up to 256, probably even more cells, spherical to slightly elongated and lobular, piled together in heaps, adhering by their very soft, gelatinous walls and forming a continuous stratum; cells spherical, 0.9–1.3 μ diam., bright aeruginous, regularly arranged in the young families, or colonies, soon arranging themselves in no definite order in the older families; tegument hyaline or almost transparent in the younger colonies, changing to honey-color, or later to dark brown, homogeneous throughout the colony.

Growing on limestone between Hatillo and Arecibo, *no. 1390,* type, and *no. 1393*; near Hato Arriba, Arecibo, *no. 1425.*

It is questionable as to whether the above newly described organism should be considered as belonging to the genus *Gloeocapsa* or to the genus *Anacystis.* It is a borderline species. In its very youngest stages, it conforms to the *Gloeocapsa* method of development. The colonies of two, four, and eight are more or less angular, the cells are symmetrically arranged, and in some cases a slight stratification of the tegument may be seen. The colonies soon become spherical, the cells are promiscuously arranged, and with no indication of stratification of the tegument. They then resemble typical members of the genus *Anacystis.* Their teguments are sticky, and the growing colonies become agglutinated into masses with lobular surfaces, in this stage superficially resembling *Microcystis ichthyoblabe* Kuetz. There seems to be no especially visible modification of the cells to form resting spores at the end of the life cycle. The teguments finally seem to become completely confluent, and the cells, probably after a period of rest, begin actively to divide and new colonies are formed in position. This seems to be a typical *Gloeocapsa* characteristic, and for this reason I have placed the material under that genus.

GLOEOCAPSA LIVIDA **minor** var. nov.

PLATE 2, FIGURE 23

Families composed of 2 (rarely more) cells, more or less agglutinated into small groups, forming with other algae, a more or less continuous stratum; cells 3 μ diam. without the tegument, spherical, bright aeruginous, 7–8 μ diam. with tegument, homogeneous; tegument hyaline, homogeneous, the younger teguments more dense than the older.

Growing in close association with certain species of filamentous Myxophyceae on limestone near Hato Arriba, Arecibo, *no. 1406 a,* type, and *no. 1397 a.*

The collection of *Gloeocapsa* mentioned above seems very close to *G. livida* (Carmich.) Kuetz., judging from the descriptions and illustrations of Kuetzing, Hassall, and Meneghini. In its present state of development the cells, in a large part, gravitate from each other after each division, but remain within the same colonial tegument. Generally they are to be found in groups of four. Certain other colonies may contain as many as sixteen cells before disintegration of their teguments. In the description of *G. livida* it is stated that the families contain "16–24 cells."

Gloeocapsa calcicola sp. nov.

PLATE 2, FIGURE 24

Cells associated into families of 2–4 or rarely 8, spherical to slightly elongated before division, 1.1–1.3 μ diam. without tegument, pale aeruginous, homogeneous; families of four, 10–12 μ diam. with tegument, cuboidal, with rounded corners; tegument hyaline, faintly lamellose.

Growing on limestone at Hacienda, Laguna Tortuguero, *no. 866,* type; on a wall in company with other species of Myxophyceae, together forming a thin, dark stratum at the Hotel Nava, Santurce, *no. 55 a.*

This is one among the most diminutive species of the genus. It is very closely related to certain species of the genus *Chroococcus,* and it is difficult to state the distinguishing characteristics of such border-line organisms. This is particularly true of the material of *no. 55 a,* which is not absolutely identical with the type, *no. 866,* but too close to be separated specifically.

Gloeocapsa ovalis sp. nov.

PLATE 2, FIGURE 25

Cells adhering into small families, rarely containing more than 4 cells, associated with other species of algae forming a thin dark stratum on rocks, 5.8–6.2 μ diam. without the tegument, 9–12 μ diam. with the tegument, spherical when alone, remaining angular for some time after division, bright aeruginous, homogeneous; families of two cells 12–14 μ long, broadly ellipsoidal, those of 4 cells 14–16 μ long; tegument hyaline, more or less lamellose on the family, homogeneous on the single cells.

Growing on limestone between Utuado and Adjuntas, *no. 1640*, type.

Gloeocapsa sphaerica sp. nov.

PLATE 3, FIGURE 26

Families spherical to irregular in outline, containing a variable number of cells, up to 128 before the dissolution of the general tegument, soft, subgelatinous, adhering to each other at times, forming masses microscopic in size; cells spherical to slightly elongated before division, yellowish green, 2–2.3 μ diam., usually separated from each other in the colony by 2–3 times their diam.; teguments homogeneous, opalescent, ample, smooth on the surface; teguments of individual cells arising soon after cell division, not persisting long, but merging into the colonial tegument.

Growing on limestone between Arecibo and Utuado, *no. 1482 a*, type.

The distinguishing feature of this species of *Gloeocapsa* is the perfectly spherical form of the young colonies with an ample, homogeneous, opalescent tegument, and not a more or less angular colony, as is the case in most species of the genus in the juvenile stage. It seems closely related to *G. squamulosa* Bréb., which has a thick, hyaline tegument. It differs from that species in having the cells associated into much larger families, with a larger number of cells in the family.

GLOEOCAPSA QUATERNATA **major** var. nov.

PLATE 3, FIGURE 27

Families composed of 2, more rarely of 4, cells, broadly ellipsoidal, 13–15 μ long, closely crowded together but not confluent; cells 3.5–4.2 μ diam. and 6.7 μ long without tegument, homogeneous, aeruginous; tegument very distinctly lamellose, hyaline, becoming yellowish brown with age.

Growing on the wall of an old conservatory, San Juan, *no. 131 a*, type.

The variety is to be distinguished from the species in having larger and ellipsoidal colonies, in having elongated cells and in having yellowish-brown tegument on the surface of the stratum when aged. The cells are distinctly elongated, a character not, strictly speaking, that of a typical *Gloeocapsa,* but the cells divide in three planes, thus excluding it from the genus *Gloeothece.*

Gloeothece interspersa sp. nov.

Plate 3, figure 28

Families more or less ellipsoidal, small, interspersed in the interstices of filamentous algae and fungi, composed of 2–4 or rarely 8 cells; families of 2 cells 13–15 μ long, of 4 cells 16–18 μ long; single cell cylindrical, with rounded ends, 3.6–4 μ diam., 7–7.5 μ long without the tegument, pale aeruginous; tegument hyaline, relatively wide, lamellose.

Growing on a wall by the Hotel Nava, Santurce, *no. 54 a,* type.

Gloeothece endochromatica sp. nov.

Plate 3, figure 29

Colonies very small, 15–25 μ diam., containing 16–32 or more cells, spherical to more or less lobed; cells 0.9 to 1.2 μ diam., 1.5–2 times as long as the diam., pale aeruginous to yellowish green; colonial tegument hyaline or slightly opalescent; single cells, or groups of 2 or more, surrounded by a relatively firm, very distinctly delimited, thick, dark-violet tegument, but not lamellose; as the cells become aged the color disappears in part.

Growing among other species of Myxophyceae on limestone, between Arecibo and Utuado, *no. 1465 a,* type.

The above-described species of *Gloeothece* structurally is on the border between the genera *Anacystis* and *Gloeothece.* The special or individual teguments appear to be fused with the general colonial tegument at times, as it does in some species of *Anacystis* but apparently no resting spores are produced, at least none could be found in the material under the stage of development in which it was found. It is also very closely related to certain species of *Gloeocapsa* of the *Cyanocapsa* section, but the presence of cylindrical cells which seem to divide in but one plane and then rotate within the colony before the next division would ally it with the genus *Gloeothece.*

Gloeothece parvula sp. nov.

Plate 3, figure 30

Families containing up to 32 cells, but usually 8–16, free or collected into small masses among other algae, not forming a definite stratum alone, 12–18 μ diam.; cells cylindrical, 1.2–1.5 μ diam., 2–3 times as long as the diam., pale aeruginous; tegument hyaline, homogeneous, ample, 3–4 times as thick as the diameter of the lumen of the cell.

Growing in association with numerous other species of Myxophyceae, near Hato Arriba, Arecibo, *no. 1410 b,* type.

The above-described species of *Gloeothece* is apparently a near relative of *G. confluens,* a species, as a rule, with only two cells in a colony.

Gloeothece opalothecata sp. nov.

Plate 3, figure 31

Colonies moderately firm and rigid, spherical, containing 2–4 cells, agglutinated into masses of indefinite extent; cells slightly elongated, 2–2.5 μ diam., 1.25–2 times as long as broad without the tegument; tegument opalescent, homogeneous, firm, about 3 times as thick as the lumen of the cell.

Growing on limestone, near Hato Arriba, Arecibo, no *1434,* type.

This species is on the border line between *Gloeothece* and *Gloeocapsa.* The cells in a state of division are mostly spherical, but when in the resting stage they average about one-half longer than broad.

The colonies remain spherical even in large masses, the mutual pressure not being sufficient to distort them, the teguments being firm. They are sufficiently sticky on the surface, however, to cause them to adhere very firmly to each other. The species has a near relative in *Aphanothece opalescens* of this paper.

Gloeothece prototypa sp. nov.

Plate 3, figure 32

Families floating free, congregated into small masses, or forming a continuous stratum, composed of 2–4 cells, very abundantly existing as single cells, those of 4 cells 7–8 μ diam.; cells cylindrical, 0.8–1.2 μ diam., 2–3 μ long, pale aeruginous; tegument very nearly colorless, homogeneous, about equal in diam. to the cells.

Growing on limestone, between Hatillo and Arecibo, *no. 1377 a,* type, and *no. 1378 a*; on a water pipe near a stream, Maricao, *no. 1147 a*; on limestone at Hato Arriba, Arecibo, *no. 1407 b;* and between Arecibo and Utuado, *no. 1481 a.*

This is a very diminutive species of *Gloeothece,* when young appearing with but very little tegument, and that almost transparent. It finally develops a visible sheath or tegument, which combines 2–4 cells, very rarely more, into small families, where it has the typical *Gloeothece* character and resembles, to a less degree, certain Bacteria.

Anacystis gigas (W. & G. S. West) comb. nov.

Gloeocapsa gigas W. and G. S. West.[1]

Growing in company with other species of Myxophyceae on limestone, between Arecibo and Utuado, *no. 1476*; between Hatillo and Arecibo, *no. 1387 b*; on old wood at Hato Arriba, Arecibo, *no. 1397 b*; on a wall in Fort San Cristobal, San Juan, *nos. 1991 c, 1993, 2002, 2003 d, 2008, 2014 c* and *2021.*

A large percentage of the species of Myxophyceae collected by Dr. Wille on Porto Rico are unicellular. Many of these species belong and may readily be associated with more or less well-recognized and clearly defined genera. Others seem decidedly to be allied with less clearly delimited genera and before these can be satisfactorily placed the limits of such genera must be either more clearly defined and amplified or new genera must be erected for their reception. In this instance I shall attempt the former procedure. Three of such genera are *Chroococcus* Naegeli, *Gloeocapsa* Kuetzing, and *Anacystis* Meneghini.

Naegeli proposed the genus *Chroococcus* in 1849,[2] selecting as the type of the genus *C. rufescens* (*Pleurococcus rufescens* Bréb.) at the same time recognizing nine other previously described species, which had been placed with one or the other of the genera *Protococcus* or *Pleurococcus.* All of these have since been very generally recognized as belonging to *Chroococcus.*

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[1] On some fresh water algae from the West Indies. Jour. Linn. Soc. Bot. 30: 276. *pl. 16.* 1895.

[2] Gattungen einzelliger Algen, 44.

Naegeli's conception of the genus as set forth in his diagnosis and in his discussion which follows seems to have been of a group whose cells exist either singly or, by division "in allen Richtungen des Raumes" and remaining for a time intact, become associated into small, spherical or cuboidal families, or colonies of 2—8 or, more rarely, 16–32 cells, surrounded by a thin colorless, homogeneous or at times slightly lamellose wall. Although Naegeli states that the wall is thin, scarcely one-third the thickness of the lumen of the cell (a thick wall as compared to the cell proper) he undoubtedly meant thin as compared to that of *Gloeocapsa,* which he discusses in connection with *Chroococcus,* and which may become several times thicker than the lumen of the cell.

The genus *Gloeocapsa* was proposed by Kuetzing in 1843.[3] He designated no type species, but the first species mentioned is *G. montana,* which may ordinarily be considered the type of a genus when no special one is proposed. His diagnosis of the genus is very brief and incomplete. In 1846,[4] he illustrated the species.

The genus was reviewed by Naegeli (*loc. cit.*), who designated as the type *G. atrata* Kuetz., which he redescribed and illustrated. I have examined bits of the type of both of these species and judging from these and from the descriptions and figures given by Kuetzing and Naegeli, both writers had practically the same conception so far as the type, *G. atrata,* is concerned. As pointed out by Naegeli and by subsequent writers, the two genera *Chroococcus* and *Gloeocapsa* undoubtedly overlap, and such forms as *G. montana* seem as clearly allied to the one as to the other. I am considering forms with a firm, smooth, hyaline wall, or tegument, with relatively few cells in a colony, and these remaining angular after division throughout the greater part of the life cycle of the colony, and such forms as remain within special teguments for several generations all remaining within a common, more or less gelatinous, original,

[3] Phycologia Generalis.

[4] Tabulae Phycologicae, **1**: *pl. 19. f. III.*

copious tegument, becoming decidedly lamellose and often variously colored, and with cells soon becoming spherical after division, as the extremes respectively of the genera *Chroococcus* and *Gloeocapsa,* both together constituting a heterogeneous group. The two genera may be kept as conveniences rather than as distinct entities, and I have so considered them in placing the various specimens of the collection. The placing of *Chroococcus limneticus* Lemm. within that section of the group seems unwarranted since that species as described has the cells embedded within a copious gelatinous tegument.

My experience from examination of many collections and cultures of both *Chroococcus* and *Gloeocapsa* reveals the fact that they both have the same general method of multiplication, viz., at times certain single cells are liberated from a colony. These usually become spherical and by division start new colonies. However, never does the entire colony go into the one-celled stage simultaneously, the cells in groups of two, four, or more, enclosed within their special tegument, continuing to divide, becoming liberated from time to time by the dissolution of the outer common tegument.

The genus *Anacystis* of Meneghini, 1837,[5] has a very different and distinct method of multiplication. Starting with a single cell always, by repeated divisions, a colony, varying in size and shape according to the species but usually spherical in form, is evolved. At maturity, when the cells cease to divide, each cell in the colony develops simultaneously a special, often highly ornate, cell-wall, and the colonial tegument then dissolves and liberates these resting cells. Each again, after a period of rest, starts another colony. The life cycle is very distinct and definite.

This cycle, although not definitely outlined by Meneghini, was clearly indicated in his drawings (*loc. cit.*). I am here emending the genus to that extent. Naegeli (*loc. cit., pl. 1, fig. F, 2–6*) has included with the type of *Gloeocapsa* organisms which, from the appearance of the drawings, have a life cycle not that of the type which he designated, but that of *Anacystis.*

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[5] Conspectus algologiae Euganeae, 6; Monographia nostochinearum Italicarum, 92, 1842.

I am excluding such species from the genus *Gloeocapsa* even though some species may have differentiated teguments within the colonial tegument, and thus emending the genus as understood by Naegeli and followed by later writers. The inclusion of such forms undoubtedly has led to the statement that resting spores are produced by certain species of *Gloeocapsa.* West's *Gloeocapsa gigas* from the West Indies clearly belongs to the *Anacystis* lineage.

Setchell and Gardner[6] have shown that Kuetzing's *Microcystis,* 1833, was not homogeneous and most of its species are to be referred to a different group of organisms from the Myxophyceae.

Anacystis nigropurpurea sp. nov.

PLATE 3, FIGURE 33

Colonies subspherical, free, 25–40 μ (up to 70 μ) diam.; cells spherical to slightly ellipsoidal, 3.5–4.5 μ diam., with a distinct dark purplish wall, contents homogeneous, obscured by the more or less opaque wall, moderately close together, arranged without order in the colony; resting cells 5–6 μ diam., with dark, smooth, homogeneous wall; tegument hyaline or opalescent, homogeneous, close-fitting or with a distinct clear margin between the cells and the surface.

Growing in depressions in limestone between Hatillo and Arecibo, *no. 1387 a,* type; on limestone, Hato Arriba, Arecibo, *nos. 1397 a* and *1399 c*; on a waterpipe in company with other Myxophyceae, Maricao, *no. 1155 f*; on the wall of a church, Sabana Grande, *no. 962 b*; on bark along the road to Monte Montoro, Maricao, *no. 1087.*

This species of *Anacystis* is one of a few species in which the cells develop a distinct, colored wall very early in the life cycle. The distinction between the vegetative cells and the resting spores is slight. The latter are somewhat larger and the cell walls are thicker, but of the same color and consistency.

Anacystis nigropurpurea seems closely related to *A. nigroviolacea* of this paper. The former has more and smaller cells in a colony than the latter. The especially distinguishing feature separating the two species is in the method of development. In germination, the resting spore of *A. nigropurpurea* apparently retains the spore wall, which, however, becomes thinner, the subgelatinous tegument being secreted on the outside of the wall, and is colorless from the beginning of germination to maturity. On the contrary, the resting spores of *A. nigroviolacea* on germination secrete the gelatinous matrix, or tegument, on the inside of the wall, which moves outward from the protoplast, becomes thinner and apparently modified, and loses much of its color. The new tegument remains faintly colored throughout the life cycle. The modification of the spore wall does not seem quite so profound as in the case of *A. gigas, A. magnifica,* etc., of this paper, in which the original morphological character of the wall is entirely lost.

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[6] Univ. Calif. Publ. Bot. **8**: 13. 1919.

Anacystis nigroviolacea sp. nov.

PLATE 3, FIGURE 34

Colonies spherical to irregular, 25–40 μ (rarely up to 80 μ) diam., free; cells 8–16 (rarely up to 64) in a colony, spherical to somewhat irregular, 4–5 μ diam. pale aeruginous, considerably obscured by the colored tegument, not closely crowded; resting spores of the same shape as the vegetative cells, 7–7.8 μ diam., with firm, smooth, dark-violet wall; tegument subgelatinous, firm and dark violet on the outside, softer and less colored toward the center of the colony.

Growing among other algae on rocks about ten kilometers north of Utuado, *no. 1553,* type; on limestone at Hato Arriba, Arecibo, *no. 1399 d*; between Arecibo and Utuado, *no. 1476 a*; on rock in Jayuya, *no. 1770 c.*

Anacystis nigroviolacea is apparently closely related to *Gloeocapsa violacea.* No statements are made in any of the descriptions, as far as I can ascertain, regarding the life history of that species, and in the absence of authentic material it is not possible at present to state the relationship. *A. nigroviolacea* has a definite life cycle producing the resting spores with modified walls characteristic of the genus as understood and outlined here. For a discussion of the relation of *A. nigroviolacea* to *A. nigropurpurea* of this paper see under that species.

Anacystis cylindracea sp. nov.

PLATE 3, FIGURE 35

Colonies spherical, up to 125 μ diam., free; cells up to 64 in a colony, widely separated, cylindrical with rounded ends, bright blue-green, homogeneous, 6–7.5 μ diam., 10–14 μ long; resting spores of the same shape as the cells, but slightly enlarged and surrounded by a thin, smooth, hyaline, membranaceous wall; tegument opalescent, ample (8–12 μ thick), homogeneous throughout the colony; spores sometimes germinate in the mother utricle, or tegument.

Growing among the Myxophyceae on rocks, between Utuado and Adjuntas, *no. 1640 a,* type.

The majority of the species of *Anacystis* have either spherical cells or cells which are more or less irregular and angular. *A. cylindracea* departs from the rule as to the form of the cells, but conforms to the typical species in its life cycle. Starting from a single cell the mature colony is built up by cell divisions after the usual manner, the resulting cells having no visible differentiated membrane, but all are embedded within a common, homogeneous, more or less gelatinous matrix or tegument. At maturity the cells develop a thin, firm, membranaceous, smooth, hyaline wall, becoming resting spores of the typical sort. At this stage it may depart from the usual procedure. The resting spores germinate in position before the dissolution of the parent utricle. A new gelatinous matrix, or tegument, is laid down within the membranaceous wall. The cells then have the appearance of certain species of *Gloeothece* with the usual special, or individual tegument. Sooner or later these young colonies are liberated and the new life cycle continues independently.

Anacystis compacta sp. nov.

PLATE 4, FIGURE 36

Colonies spherical to irregular in outline, free, 25–60 μ diam.; cells slightly angular, closely packed together in the juvenile stage, becoming rounded, almost spherical, at maturity, 4.5–5.5 μ diam., bright aeruginous, homogeneous; resting spores subspherical, with a conspicuous, smooth wall, 6–6.5 μ diam.; tegument firm, smooth, homogeneous, close-fitting, hyaline when young, becoming yellowish or brown.

Growing on bark of a tree trunk, in Caguas, *no. 439,* type.

This species may be distinguished from others by the closely compacted, angular, bright blue-green cells embedded within a close-fitting, firm tegument, hyaline in juvenile stage, becoming yellow or brown at maturity.

Anacystis distans sp. nov.

Plate 4, figure 37

Colonies 20–35 μ diam., spherical, of gelatinous consistency, free; cells spherical, about 2 μ diam., very pale aeruginous, 16–32, rarely 64, in a colony, considerably separated from each other, usually 2–3 times their diameter; resting spores unknown; sheath homogeneous throughout the colony, ample, somewhat gelatinous.

Growing among other species of Myxophyceae on a water pipe by a flume near Maricao, *no. 1155 e,* type; and *1148 b;* on limestone between Arecibo and Utuado, *no. 1465 a.*

From the descriptions and figures of *Gloeocapsa punctata* Naeg., *Anacystis distans* is very closely related to it, but the colonies are larger and have more cells, which are more nearly of uniform size. From all appearances *G. punctata* Naeg. is a true *Anacystis,* going through the same life cycle as the one described for this genus under *Anacystis gigas* in this paper.

Anacystis magnifica sp. nov.

Plate 4, figure 38

Colonies spherical to subspherical, free, 80–125 μ (up to 175 μ) diam.; cells angular, irregular in shape and size, 11–15 μ diam., bright aeruginous, not densely crowded together, coarsely granular; resting spores 18–22 μ (up to 30 μ) diam., of the same shape as the cells, with a thick, hyaline wall closely beset with hyaline spines about 6 μ long, teguments firm, homogeneous throughout the colony, hyaline, 7–12 μ thick outside of the colony of cells.

Growing in association with other Myxophyceae, on a wall in Fort San Cristobal, San Juan, *no. 2016 a,* type; on a water pipe near a stream at Maricao, *no. 1148 c.*

Anacystis magnifica is one member of the group of the genus in which the resting spores are much larger than the vegetative cells from which they arise, and it has more or less highly ornate spore walls. The white spines remain on as remnants until the new colony arising from the resting cells has attained almost half the mature size, but they disappear very gradually. At maturity no trace of them is to be seen on the limiting membrane.

Anacystis microsphaeria sp. nov.

PLATE 4, FIGURE 39

Colonies spherical to slightly irregular in outline, some specimens being cubical with rounded corners, free, 20–35 μ diam.; cells spherical to decidedly angular after division, or remaining angular to maturity, 3–3.5 μ diam., pale aeruginous, closely aggregated; resting spores angular, fitting close together in the colony, with a thin, firm, membranaceous, smooth, brown wall, 5.8 μ diam.; tegument firm on the margin, more or less lamellose, yellowish to dark brown.

Growing among other Myxophyceae on a wall at Coamo Springs, *no. 299 a,* type.

The above is a small species distinguished by its relatively large, brown, smooth-walled resting spores combined with its tough, close-fitting, lamellose, colonial tegument.

Anacystis amplivesiculata sp. nov.

PLATE 4, FIGURE 40

Colonies 50–80 μ (up to 150 μ) diam., spherical to irregular in form, free; cells spherical to irregular in outline, not closely congested, 5.2–6 μ diam., bright aeruginous, homogeneous; resting spores with a distinct hyaline, finely papillate wall, 8–9 μ diam.; tegument opalescent, firm, smooth on the surface, homogeneous throughout the colony, 6–10 μ thick outside of the cells.

Growing on bark by the road to Monte Montoro, Maricao, *no. 1087 a,* type, and *no. 1088 a*; on a church wall at Sabana Grande, *no. 962 c.*

Anacystis amplivesiculata is a very distinct and beautiful species, with the spherical, bright bluish-green cells set in a clear, opalescent matrix, and with resting spores surrounded by a distinct, hyaline, papillate wall. Frequently the cells of an entire colony divide simultaneously just before spore formation and the spore wall begins to form at the beginning of division.

Anacystis gloeocapsoides sp. nov

PLATE 4, FIGURE 41

Colonies spherical, more or less associated into groups adhering by their sticky walls or floating free, 15–30 μ diam.; cells not densely crowded in the colony, each secreting a tegument differentiated from the colonial tegument, 2–4 cells at times remaining in the special tegument for some time before its fusion with the general tegument, pale aeruginous, 2–2.4 μ diam.; resting spores only slightly changed vegetative cells; tegument firm and smooth on the surface, rather close-fitting, coral red, lamellose throughout the colony, the special teguments usually colored brighter than the colonial tegument.

Growing in association with other species of Myxophyceae on rocks by Laguna Joyuda, Mayagüez, *no. 1304,* type.

This species of *Anacystis* seems closely related to *Gloeocapsa rosea* Kuetz., judging from Kuetzing's original description. The description is, however, incomplete regarding the life history, and no specimens are available for comparison.

Anacystis nidulans sp. nov.

PLATE 4, FIGURE 42

Colonies spherical, 25–40 μ diam., free; cells usually 16–32 in a colony, but up to 64, subspherical to irregularly angular, 3.5–4.5 μ diam. in the juvenile stages, larger at maturity, pale aeruginous, homogeneous; resting spores 7.5–9 μ diam., of the same shape as the vegetative cells, with a thin, membranaceous, smooth, coral-red wall, obscuring the contents, densely crowded together within the mother utricle; sheath close-fitting, submembranaceous, and coral-red on the surface, pale pinkish in the interior.

Growing on bark near Laguna Joyuda, Mayagüez, *no. 1207 a,* type.

Anacystis pulchra sp. nov.

PLATE 4, FIGURE 43

Colonies spherical, 45–70 μ (up to 150 μ) diam., free, containing 32–64 (up to 128) cells, not forming a stratum; cells not congested in the colony, spherical to very irregular in outline, 7.5–10 μ diam., aeruginous, homogeneous, remaining in sheaths for some time, forming groups of 4–16 before the teguments become homogeneous; resting spores of the same shape as the cells, 11–14 μ diam., with a dense, thin, coral-red wall, smooth or very finely granular; tegument firm, smooth and rigid on the surface, more or less lamellose, coral-red, or pink, deeper color on the surface and on the separate tegument, paler in the general mass.

Growing with other Myxophyceae on the soil by the road toward Monte Montoro, Maricao, *no. 1094,* type.

Anacystis Willei sp. nov.

Plate 5, figure 44

Colonies spherical, smooth, very variable in size, to 200 μ diam.; cells spherical to somewhat compressed, not densely crowded, 5–6 μ diam., remaining in separate teguments for some time in groups of 2 or 4, bright aeruginous, homogeneous; tegument tough, more or less lamellose throughout the colony, 4–5 μ thick outside of the group of cells, hyaline, changing with age to rose-pink or coral-red; resting spores 7–8 μ diam., coral-red, smooth.

Growing interspersed among other Myxophyceae near Laguna Joyuda, Mayagüez, *no. 1209 a,* type; on soil by the road to Monte Montoro, Maricao, *no. 1094 a*; on rocks in a ravine by Coamo Springs, *no. 1901 d*; on rocks near Laguna Joyuda, Mayagüez, *no. 1307 a*; on rocks, Jayuya, *no. 1770 a.*

This species of *Anacystis* belongs to a group in which the cells secrete separate teguments which do not immediately fuse with the general colonial tegument. When the color begins to develop these separate sheaths become very visible.

Anacystis irregularis sp. nov.

Plate 5, figure 45

Colonies very variable in shape and size, up to 75 μ diam., closely associated into masses of considerable size, the teguments of the older colonies at times completely fusing; cells spherical, closely crowded together, 1.8–2.5 μ diam., bright aeruginous, homogeneous; resting spores with a very thin, smooth, hyaline wall; tegument close-fitting, hyaline, homogeneous throughout the colony.

Growing among other species of Myxophyceae on the trunks of trees, Coamo Springs, *no. 300,* type; on "Flytteblok" west of Humacao, *no. 577 a*; on rock near Hacienda Catalina, Palmer, *no. 791 a*; on lava rock by the road to Monte Montoro, Maricao, *no. 1065 d.*

As this species is piled together and at times in part confluent, it resembles Kuetzing's illustrations of *Polycystis ichthyo-*

blabe, but there is not the continuous colonial tegument, except in part where the colonies are old, characteristic of that species.

Anacystis minutissima sp. nov.

PLATE 5, FIGURE 46

Colonies spherical to somewhat irregular in outline, 15–25 μ (up to 45 μ) diam.; cells densely crowded together, 0.8–1.2 μ diam., pale aeruginous, often tinged with yellow; tegument thin, homogeneous, close-fitting, hyaline.

Growing in association with other Myxophyceae among moss on a water pipe near a stream, Maricao, *no. 1194 a,* type; on tree trunks, Coamo Springs, *no. 300 d*; on a wall at a bridge in Caguas, *no. 462*; on broken rock about seven kilometers east of Coamo, *no. 1869 e*; on a wall at Hot Springs, *no. 402 b*; in the overflow from a hot opening, Coamo Springs, *no. 402 b*; on a brick wall near Juan Martin, Fajardo, *no. 732 a*; in the overflow from a hot spring, Coamo Springs, *no. 367 e.*

The specimens of this species of *Anacystis* are almost perfect spheres when young, and for the most part retain the shape to maturity. Apparently the resting spores merely develop a very thin, smooth wall at maturity. The species seems closely related to *A. firma* (Bréb. & Lenorm.) Schmidle, but does not form the firm, mucous stratum characteristic of that species. There is also much less variation in the size of the cells.

Anacystis consociata sp. nov.

PLATE 5, FIGURE 47

Colonies spherical, quite firm, 25–50 μ diam.; cells spherical to somewhat irregular, bright bluish green, homogeneous, 2.8–3.4 μ diam., closely associated, leaving a distinct margin of tegument on the surface; resting spores with thin, hyaline, smooth walls; tegument homogeneous throughout the colony, hyaline, smooth.

Growing in association with other species of Myxophyceae. Very widely distributed. The following are a few of the localities noted: on a wooden fence near Santurce, *no. 2 c,* type; on a wall, Hotel Nava, Santurce, *no. 56 j*; Coamo Springs, *nos. 300 a* and *1901 c*; on tree trunks, Fajardo, *no. 656*; on a church wall, Sabana Grande, *no. 961 d*; on a garden wall, Hotel Paris, Mayagüez, *no. 981 b*; on a tree trunk along the road near Monte Montoro, Maricao, *no. 1062*; on soil, Hacienda Holm, Mayagüez, *no. 1176 b.*

Anacystis radiata sp. nov.

PLATE 5, FIGURE 48

Colonies spherical, 50–80 μ diam., not collected into masses, but free as a rule; cells numerous (100–300) in a colony, mostly angular, moderately crowded, about 4 μ diam., arranged in radial rows, dividing in three planes, the cells on the surface appearing in groups of 2 or 4, dark olive-green or olive-gray, homogeneous; resting spores with thin, smooth walls; tegument firm, smooth, hyaline, homogeneous throughout the colony, about 6 μ thick outside of the cells.

Growing in association with other species of Myxophyceae, on rocks in a ravine, Coamo Springs, *no. 1901 a,* type; on a wall, Governor's Palace, San Juan, *no. 58 b*; on old wood in the primeval forest at Hacienda Catalina, *no. 755.*

It is difficult to decide whether the above organism should be placed in the genus *Anacystis* or in the genus *Pleurocapsa.* It resembles the latter very strongly in the vegetative condition, but since there are no gonidia, a characteristic of that genus, I am placing it with the former in a group with radiating angular cells, awaiting further knowledge of its life history.

ANACYSTIS RADIATA **major** var. nov.

PLATE 5, FIGURE 49

Colonies spherical, 50–75 μ diam.; resting spores 10–11 μ diam., otherwise as the species.

Growing on shaded rock about seven kilometers east of Coamo, *no. 1869 f,* type, and *no. 1870 x.*

Anacystis anomala sp. nov.

PLATE 5, FIGURE 50

Colonies very irregular in shape and size, with a tendency to being cuboidal with rounded corners in the earlier stages of development, containing approximately 1000 cells; single, free cells spherical to subspherical, 2.8–3.2 μ diam. with tegument, cuboidal in the colony and 1.3–2.5 μ diam. without wall, arranged quite definitely in rows in the medium-sized colonies, the colonies often becoming much lobed when old; tegument thin, smooth, and hyaline.

Growing in company with other Myxophyceae on a wall, Juan Martin, Fajardo, *no. 732 b,* type.

This species is certainly aberrant. It does not conform to any known genus in all of the stages of its life cycle. In the young stages, the colonies, up to 8 cells, resemble a typical species of *Chroococcus.* From this time on, the development is not symmetrical. Certain cells cease to divide temporarily or permanently, while others become very active, eventually resulting in a colony more or less lobed and irregular in form. The divisions proceed in three planes, the cells remain cuboidal, having thin, hyaline walls and are arranged in rows. In this stage the colony is not unlike certain species of *Pleurocapsa.* The material is in all stages of development and there are no gonidia. The colonies seem to break up at maturity, freeing the cells which then become spherical and develop a special wall. Although not â typical *Anacystis,* it seems to correspond more nearly to the stage of development in the life cycle of that genus than to any other.

ENDOSPORA gen. nov.

Cells dividing in three planes, approximately perpendicular to each other, resulting in cuboidal to more or less spherical colonies; cells more or less angular, with membranaceous walls; all cells in the colony at maturity producing resting spores by thickening on the inside of the original separating walls, the spores being liberated by the dissolution of the colonial wall. Type species, *Endospora rubra.*

The genus possesses a combination of characters not found in any other genus of the Chroococcaceae. The combination seems sufficient for generic distinction. I am therefore proposing the above diagnosis under the term *Endospora* to take care of several collections whose characters would not permit their being placed elsewhere. The new genus has some features which remind one of the genus *Pleurocapsa,* as it does likewise some members of the genus *Chroococcus,* but neither of these genera produces, so far as is known, endogenous resting spores by the secretion of a special wall around the whole protoplast of each cell in the colony, and in neither is there such a definite membranaceous wall separating the protoplasts. Another method of reproduction would have to be added to the Chamaesiphonaceous genus *Pleurocapsa* in addition to its schizogenous method of producing gonidia, and likewise the Chroococcaceous genus *Chroococcus* would have to be emended to incluude such forms producing specialized resting cells. It resembles the typical species in the genus *Anacystis* in having a definite life cycle, at the end of which all of the cells of the colony are simultaneously changed into resting spores, the so-called rejuvenescent period. It differs from *Anacystis* in that the cell walls are membranaceous and adhere by their entire surface until maturity, instead of being cartilaginous, mucilaginous, or gelatinous, as in *Anacystis,* such walls expanding more or less and permitting the protoplasts to migrate from each other to variable and considerable distances.

Endospora rubra sp. nov.

PLATE 5, FIGURE 51

Colonies variable in size, more or less cuboidal, with rounded corners, containing 8–32 cells, rarely 64 cells; cells pale aeruginous, more or less obscured by the pinkish or coral-red cell walls, at maturity angular; resting spores 8.5–9.5 µ diam.

Growing on lava rock among other Myxophyceae at Coamo Springs, *no. 1916 a,* type, and *nos. 1912 a* and *1923 a*; on rocks near Laguna Joyuda, Mayagüez, *no. 1209 b* and *1301 a*; on old wood by Hot Springs, Coamo Springs, *no. 405*; north of Mayagüez, *no. 1000 e.*

Endospora mellea sp. nov.

Colonies variable in size, more or less cuboidal with rounded corners, containing 4–16 cells, rarely more; yellowish or honey-colored, closely crowded together; resting spores with thin yellowish walls, 6.5–8 µ diam., decidedly angular.

Growing on rock about ten kilometers north of Utuado, *no. 1533 a,* type; on rocks in Jayuya, *no 1770 d*; on limestone at Guanica, *no. 1840 a.*

Endospora bicoccus sp. nov.

PLATE 5, FIGURE 52

Cells existing singly or in pairs, very rarely in fours, free among other algae, not forming a stratum; single cells irregular in size and form, spherical to ovoid, 2.5–3.8 μ diam., becoming ellipsoidal before division; colonies of two or four 7.2–8.4 μ diam.; walls pinkish or brick red; resting spores rounded, walls conspicuous and smooth.

Growing on soil by the road to Monte Montoro, Maricao, *no. 1071 d,* type, and *no. 1077 e.*

A very large majority of the colonies in the above species contain only two cells. When the resting spores are forming, the appearance is that of the ordinary cell-division of *Synechococcus,* and were it not for the presence of a distinct cell-wall and the fact that some of the colonies came to the four-celled stage by divisions in two planes, it might be placed in that genus. It is not quite typical of the genus *Endospora,* which forms more complex colonies by divisions in three planes, but it forms resting spores after the manner of that genus.

Endospora nigra sp. nov.

PLATE 5, FIGURE 53

Families free among other algae, containing 2–4, more rarely 8 cells, the 8-celled families 11–14 μ diam.; cells 3.5–5 μ diam. in the family, contents obscured by the very dark-colored walls, in part almost black; resting spores 5–6 μ diam., spherical to irregular.

Growing on trees north of Sabana Grande, *no. 925,* type.

Endospora olivacea sp. nov.

Families containing as many as 64 cells, but usually fewer, varying from angular to subspherical, free or more or less accumulated into small masses; cells angular in the colony, 4–5 μ diam., dark olive-green, wall dark olive to dark drab, firm, smooth and homogeneous; resting spores spherical to irregular in form, 6–7 μ diam.

Growing among other Myxophyceae on a wall in Caguas, *no. 462 a,* type.

Endospora olivacea is similar to *E. rubra* and *E. mellea,* but may readily be distinguished by the dark olive or drab color.

Placoma Willei sp. nov.

PLATE 6, FIGURE 54

Colonies 75–100 μ (up to 350 μ) diam., spherical, subspherical or irregular in outline, tough and cartilaginous, more or less gelatinous on the surface; cells spherical, 2–2.4 μ diam., usually appearing in groups of 2 or 4 on the surface of the colony; colonial tegument more or less hyaline; individual cells and groups of 2–4 enclosed in special teguments more or less deeply colored violet or purplish.

Growing at "Campo" north of Maricao, *no. 1290 c,* type collected by Dr. N. L. Britton; on bark, Utuado, *no. 1506 c*; on rocks, near Laguna Joyuda, Mayagüez, *no. 1209.*

Entophysalis chlorophora sp. nov.

Plate 6, figure 55

Plants forming a more or less continuous stratum 50–100 μ thick on the surface of smooth pebbles, firm and cartilaginous; cells 2–2.5 μ diam., angular, arranged more or less in rows perpendicular to the substratum, forming somewhat false-branched filaments embedded within the common tegument, greenish aeruginous.

Growing on pebbles in a stream of warm water by Hot Springs, Coamo Springs, *no. 381,* type.

Entophysalis violacea sp. nov.

Plate 6, figure 56

Plants forming microscopic cushions 60–80 μ thick on rock, subcartilaginous; cells 1.5–2.5 μ diam., spherical to radially elongated, arranged in radial, more or less false-branched filaments perpendicular to the substratum; cells embedded more or less in individual teguments all agglutinated into a common tegument opalescent on the interior of the colony, violet on the surface.

Growing on rocks at Hato Arriba, Arecibo, *no. 1433,* type.

CYANOTHRIX gen. nov.

Plants filamentous, cylindrical, monosiphonous, composed of a single series of cells generated by fission in one plane and held together by an ample gelatinous tegument. Type species, *Cyanothrix primaria.*

In creating this genus it is unfortunate that the material upon which it is based is not more abundant in the collections than I have been able to locate. The plants are very sparsely scattered among other algae and debris. Thus it has been impossible to learn much of their life history. What little is known, however, is so distinct from any known genus that it becomes necessary to create a new genus for their reception. I am placing it provisionally in the family Chroococcaceae, seemingly approaching the simplest members of the Oscillatoriaceae. The cells divide by fission and are soon separated completely by a thick, firm gelatinous membrane or tegument, continuous with the general enclosing tegument.

Nothing is known of the method of reproduction, but probably it is by the dissolution of the tegument, freeing the individual cells, as in other Chroococcaceae, these again evolving new filaments.

Cyanothrix primaria sp. nov.

Plate 6, figure 57

Filaments relatively short, about 300 μ long, straight or more or less flexuous, 18–22 μ diam.; cells discoid, closer together or farther apart according to age, 10–15 μ diam., 3.6–5 μ long, aeruginous, homogeneous; tegument smooth on the surface, relatively thick, firm, homogeneous, hyaline.

Growing among other algae in Laguna Tortuguero, *no. 830 b*, type, and *849 c.*

Cyanothrix Willei sp. nov.

Plate 6, figure 58

Filaments about 200 μ long, 9–11 μ diam.; cells 6–6.5 μ diam., 3.5–4.5 μ long, homogeneous or very finely granular, pale aeruginous; tegument almost transparent, about 2 μ thick, smooth.

Growing among other algae in Laguna Tortuguero, *no. 830 e*, type, and *no. 844 e.*

Cyanothrix Willei resembles *C. primaria* very closely but is only about one-half as large as that species. No intermediate sizes were observed and although it is possible for a species to vary as much as this from generation to generation, it seems best to keep these two separate and await the accumulation of data on this point, when an accurate decision as to their disposition may be arrived at.

Pleurocapsa epiphytica sp. nov.

Plate 6, figure 59

Thallus very diminutive, 25–40 μ diam., 12–16 μ (rarely 20 μ) thick; basal portion composed of angular cells, 3.5–5 μ diam., without any definite radial arrangement, erect portion composed of short, fairly definite, unbranched filaments with cells 2.8–3.2 μ diam., and about the same in length; gonidangia all terminal and simple, 4.5–6 μ diam.; gonidia 1–1.5 μ diam.

Growing on *Cladophora* sp. in a pool about four kilometers north of Mayagüez. The only specimen of the species is *no. 1323 b,* type.

This is the smallest species of the genus that has been published. It has a very definite and characteristic method of developing the basal portion of the thallus. The gonidium divides into two cells, after which each elongates and divides in the plane perpendicular to the first, producing four cells of equal size. Any one or all of these four cells may divide, but usually the plane of division is radial from the center of the four. After this the dividing planes are usually in any direction perpendicular to the host, and the radial arrangement of the cells soon disappears. Divisions of the cells in the center of the thallus by planes horizontal to the host produce the erect series of cells, in this case unbranched and each series composed of three to five cells.

There is very little choice as to whether this species should be placed in the genus *Pleurocapsa* or *Radaisia.*

Radaisia Willei sp. nov.

Thallus very variable in shape and size, 30–40 μ thick; early stages in the development unknown; erect filaments more or less branched and coalesced, irregular in diam., composed of cells 3.5–5 μ diam., one-half to one-third as long as the diam.; color purplish violet; gonidangia terminal, simple.

Growing on stones in company with several other species of Myxophyceae in a brook west of Humacao, *no. 593,* type.

It is very difficult to make out the limits and character of the basal portion of this species because of the presence of other encrusting Myxophyceae, *e.g., Xenococcus,* with which it has to compete for space.

Radaisia confluens sp. nov.

Thalli more or less indefinite and confluent, 50–60 μ thick, the early stages in the development unknown; erect filaments more or less compound and branched, closely crowded and confluent, composed of 8–13 cells; gonidangia unknown; cells more or less rounded, 2.5–3.2 µ diam., purplish-violet.

Growing in a fountain in the woods near Maricao, *no. 1076,* type; in a brook near San Lorenzo, *no. 498*; on stones in Rio Grande, near Sabana Grande, *no. 915*; and in a stream near "Campo," Maricao, *no. 1233.*

R. confluens resembles *R. epiphytica* S. & G., a species growing on marine algae. Unfortunately, the material is immature, the gonidangia not showing definitely.

Xenococcus Willei sp. nov.

Plate 7, figure 60

Cells forming extensive colonies often completely encircling the host and extending its entire length, very variable in shape and in size, decidedly angular in the juvenile stages, those destined to become gonidangia becoming rounded on approaching maturity, bright aeruginous, homogeneous; gonidangia broadly pyriform to decidedly irregular, 15–20 µ (up to 30 µ) diam.; gonidia numerous, 2.5–3 µ diam.

Growing on *Lyngbya majuscula* Harvey, in a stream about five kilometers east of Coamo, *no. 221 e,* type; on twigs in a stream near Maricao, *no. 1260.*

The nearest known relative of *X. Willei* apparently is *X. Kerneri* Hansgirg, from which it differs in that it forms much more extensive colonies and in that the cells are considerably larger in all of their dimensions. This, as far as I am aware, is the second species which has been reported from fresh water.

Chamaesiphon portoricensis sp. nov.

Plate 7, figure 61

Filaments cylindrical, rounded at the outer end, 6–8 µ long, 2.3–2.5 µ diam., mostly solitary; contents of cells pale aeruginous; walls of gonidangia very thin and evanescent.

Growing on filamentous green algae, in a ditch by Hot Springs, Coamo Springs, *no. 396,* type; about four kilometers north of Mayagüez, *no. 1323 x.*

The size and shape of this species would seem to relate it to *Chamaesiphon minimus* Schmidle. It is nearly twice as large in all of its dimensions.

Chamaesiphon Willei sp. nov.

PLATE 7, FIGURE 62

Filaments 50–70 μ (up to 180 μ) long, 5.8–7.2 μ diam., erect, cylindrical to slightly clavate, tapering suddenly at the base to a short stipe, straight or at times curved above; divisions of the protoplast by horizontal walls proceeding as the filaments elongate, at maturity the entire protoplast except 1–2 cells at the base changing into gonidia.

Growing on *Oedogonium* sp. in a water reservoir in Rio Piedras, *no. 119 b,* type; in a water reservoir, Rio Piedras, *no. 105 a.*

The plants of *C. Willei* are the longest that have yet been described. Although the majority average from fifty to seventy microns, they occasionally attain a length of one hundred and eighty microns. The method of gonidia formation seems different from other members of this section of the genus. Division of the protoplast begins when the filament is only a few microns long and continues as the filament elongates. At maturity the gonidia are formed almost simultaneously.

Oscillatoria tortuosa sp. nov.

PLATE 7, FIGURE 63

Trichomes very tortuous, at times completely circinate, relatively short, 2.5 μ diam.; cells cylindrical, quadrate to one-third as long as broad, homogeneous to very finely granular, pale aeruginous; cross walls inconspicuous, not granular; 2–4 apical cells acute-conical, at times slightly uncinate.

Growing on or within the gelatinous tegument of *Aphanothece conferta* P. Richt. on a water pipe near a stream by Maricao, *no. 1147 a,* type.

A species closely related to *Oscillatoria articulata,* but is tortuous, attenuate, and at times uncinate.

Oscillatoria articulata sp. nov.

PLATE 7, FIGURE 64

Plants aggregated into thin, aeruginous strata or scattered among other algae; trichomes long and flexuous, 2.8–3.2 diam., neither attenuated, uncinate, nor constricted at the dissepiments; cells quadrate to one-half or one-third as long as the diameter in rapid division; cross walls very conspicuous, at times as thick as the length of the adjacent cells; end cell rounded, wall not thickened.

Growing on mud and floating among other algae in a pool near Laguna Guanica, *no. 1822,* type; in a pool four kilometers north of Mayagüez, *nos. 1312 a, 1327 b,* and *1329*; on damp rocks about twelve kilometers north of Utuado, *no. 1514 b.*

This species of *Oscillatoria* is well marked by the conspicuity of the cross cells. They are very white and relatively wide, giving the trichomes the appearance of being jointed. It appears to be a relative of the *tenuis* group.

OSCILLATORIA ARTICULATA **circinata** var. nov.

PLATE 7, FIGURE 65

Trichomes short and circinate, making several complete turns, otherwise as the species.

Growing about four kilometers north of Mayagüez, *no. 1329 y,* type. Specimens of this form have been seen in collections under various numbers but the cause of the peculiar habit of rolling up I am unable to explain.

Comparable perhaps with *Oscillatoria gloiophila* Grun. but is smaller and lacks the granules at the cross walls reported in that species.

OSCILLATORIA TENUIS **levis** var. nov.

PLATE 7, FIGURE 66

Plants not forming a definite stratum, but distributed among other algae; trichomes 6.8–7.8 μ diam., not constricted, end walls decidedly thickened; contents homogeneous or with a few scattered fine granules in rapidly dividing cells.

Floating among numerous other algae, both Chlorophyceae and Myxophyceae, in the Turabo River near Caguas, *no. 486 a,* type; in a ditch along the way to the Playa, Fajardo, *no. 696 b.*

Most of the plants referred to *O. tenuis* Agardh do not have the end walls thickened. Gomont does not figure them in his monograph of the Oscillariées as having capitate or thickened ends, although according to his description the end wall should be slightly thickened.

The plants described here vary from the species in having decidedly thickened end walls, in not being constricted at the cross walls, and in not having granules collected at the cross walls.

Oscillatoria Willei sp. nov.

PLATE 7, FIGURE 67

Plants forming an indefinite stratum; trichomes pale aeruginous, flexuose, uncinate to semi-spiral at the apices, blunt, 2.4–2.6 μ diam.; cells quadrate to 2 times as long, homogeneous, walls inconspicuous, not constricted; terminal cell blunt, rounded, not thickened.

Growing among water plants in a reservoir at the Experiment Station, Rio Piedras, *no. 169,* type, and *192 a*; in a water fall in a brook of warm water, Coamo Springs, *no. 369,* and in a ditch at that spring, Coamo Springs, *no. 391 a.*

Oscillatoria Willei is closely related structurally to *O. laetevirens* Crouan. It differs from that species in being smaller, in not being constricted at the cross walls, in not being acute at the apices, and in not being granular. The apices are at times almost spiral.

OSCILLATORIA CHALYBEA **insularis** var. nov.

PLATE 7, FIGURE 68

Trichomes straight except at the slightly unicinate apices, and relatively rigid, 6.4–7.2 μ diam., not constricted; cells quadrate or less than the diameter long, otherwise as the species.

Collected by Dr. W. C. Earle in the vicinity of Manati, Porto Rico, growing on aquatic plants and free-floating.

OSCILLATORIA CHLORINA **conica** var. nov.

PLATE 7, FIGURE 69

Trichomes long, arcuate, 3.4–3.6 μ diam.; cells quadrate to one-half longer than the diam.; cross-walls obscure; apical cell conical.

Collected by Dr. W. C. Earle in the vicinity of Manati, Porto Rico, growing on aquatic plants and free-floating.

Oscillatoria Earlei sp. nov.

PLATE 8, FIGURE 70

Trichomes very small in diam. and short, straight except at the sharply attenuated and uncinate ends, 2.2–2.4 μ diam., not constricted at the dissepiments; cells aeruginous, quadrate to 2.5 times as long as the diameter, homogeneous, apical cell very sharply conical and uncinate, cross-walls inconspicuous.

Collected by Dr. W. C. Earle in the vicinity of Manati, Porto Rico, growing attached to water-inhabiting plants or free.

This is a very small but distinct species of *Oscillatoria* belonging to the Attenuatae section of the genus as outlined by Gomont.

Oscillatoria granulata sp. nov.

Plate 8, figure 71

Plants not forming a distinct stratum, but interspersed among other algae; trichomes relatively long and flexuous, neither constricted nor attenuated, 3.4–3.8 μ diam.; cells for the most part quadrate, conspicuous by the presence of granules at the distinct cross-walls; apical cells blunt, end wall slightly thickened.

In a pool at the Park, Santurce, *no. 51 b,* type.

The species is especially marked by the large granules crowded at the cross-walls. In mature specimens even the terminal walls have them. The terminal wall is not very conspicuously thickened.

Oscillatoria claricentrosa sp. nov.

Plate 8, figure 72

Stratum inconspicuous; trichomes relatively straight and rigid, 2.3–2.5 μ diam., apices straight or slightly uncinate, acute, very slightly constricted at the cross-walls; cells up to 11 μ long, 3–5 times as long as the diameter, though usually 6–8 μ long; protoplast with a clear central area, the denser colored portion free from granules, crowded close to the periphery; cross-walls indistinct.

Forming a thin stratum on mud in a ditch near Playa, Fajardo, *no. 697,* type.

This species belongs in the Attenuatae section of Gomont (Monogr. p. 224) and is closely akin in form to *Oscillatoria longearticulata* Hansg. and narrower than *O. acuminata* Gomont. It is to be distinguished by its relatively long cells with conspicuously clear centers free from granules. It is larger in diameter than *O. longearticulata* and narrower than *O. acuminata.*

Oscillatoria obtusa sp. nov.

PLATE 8, FIGURE 73

Trichomes straight or arcuate, moderately rigid, 23–25 μ diam., bright aeruginous, straight and not attenuated at the apices, or very slightly bent and narrowed in the last two or three cells, terminal wall slightly thickened; cells 4–6 times shorter than the diameter, homogeneous; cross-walls very thin but plainly visible.

Growing in a pool in Borinquen Park, Santurce, *no. 807*, type; in Turabo River near Caguas, *no. 486 a*; in a ditch near the Playa, Fajardo, *no. 696 e.*

Oscillatoria refringens sp. nov.

PLATE 8, FIGURE 74

Trichomes bright aeruginous, rigid or more or less flexuous, not constricted at the dissepiments, two or three end cells slightly tapering, not uncinate, terminal wall thickened; terminal cell somewhat enlarged, 9–10 μ diam.; cells short, 1.8–2 μ long, with occasional biconcave, refringent cells, slightly larger than the trichome, interspersed, homogeneous.

Growing among water plants in the Turabo River, Caguas, *no. 486 b,* type, and *no. 478*; upon water plants, Jayuya, *no 1756.*

The biconcave, refringent cells are sufficiently abundant in a mass of trichomes to characterize the species, but there are some trichomes, especially young trichomes, which have none. The mature filaments develop a characteristic end resembling very much *Oscillatoria proboscidea* but the end is straight and the trichome is less in diameter than in that species. It is also close to *O. anguina* Bory, but lacks the attenuated terebriform apices characteristic of that species.

Lyngbya erecta sp. nov.

PLATE 8, FIGURE 75

Filaments relatively straight and more or less parallel, attached at one end, forming a dense velvety stratum, 4–7 mm. long, 3.5–4 μ diam.; trichomes 1.4–1.6 μ diam., not constricted at the dissepiments, not attenuated at the apices; cells mostly quadrate, but varying from slightly shorter to 2 times as long as the diameter, cross-walls moderately conspicuous, apical cell rounded, terminal wall not thickened; sheath subgelatinous, hyaline, homogeneous.

Growing on stones in a brook in the vicinity of San Lorenzo, *no. 501 a,* type.

LYNGBYA KUETZINGII **minor** var. nov.

PLATE 8, FIGURE 76

Filaments 50–80 μ long, 1.2–1.4 μ diam., straight, erect, and rigid; cell-walls conspicuous; sheath scarcely discernible; otherwise as the species.

Growing on *Cladophora* in a pool about four kilometers north of Mayagüez, *no. 1323 a,* type.

Variety *minor* was growing in company with what seems to be typical *L. Kuetzingii* Schmidle.

Lyngbya ocreata sp. nov.

PLATE 8, FIGURE 77

Filaments short and tortuous, not forming a definite stratum, 7–8.5 μ diam.; trichomes 5.6–7.2 μ diam., not constricted at the dissepiments; apices very slightly attenuated; cells 1–1.4 μ long, contents homogeneous, pale aeruginous; cell walls very thin but distinct; terminal cell capitate, sheath at first hyaline and homogeneous, later becoming thicker and dense, becoming yellowish and finally dark brown, in part lamellose and decidedly ocreate.

Growing on damp earth by Playa, Fajardo, *no. 710 c,* type.

The material of this species was found associated with several species of Myxophyceae. The soil on which it grew is said by Wille to be "brackish," but no further comment was given.

The crooked filaments with brown ocreate sheaths remind one at first of the genus *Scytonema,* but it has neither heterocysts nor branching. The trichomes appear to have had several periods of growth. At times they extend entirely beyond the parent sheath, and are naked. Another region may have a hyaline sheath, another farther back may be decidedly colored and ocreate, the oldest part of which may be considerably thickened. Apparently the species is not abundant and not widely distributed.

Lyngbya scytonematoides sp. nov.

PLATE 8, FIGURE 78

Filaments tortuous, not forming a definite stratum, 16–20 μ diam.; trichomes 11–13 μ diam., one or two apical cells tapering, blunt, terminal wall slightly thickened; sheath hyaline, changing to yellowish or brown, homogeneous, becoming lamellose in part, and rarely somewhat ocreate.

Growing on damp earth by Playa, Fajardo, *no. 710 b,* type.

Lyngbya magnifica sp. nov.

PLATE 8, FIGURE 79

Filaments long, relatively straight and rigid, 32–40 μ diam., forming a thin, loose stratum; trichomes 28–36 μ diam., not attenuated at the apices, not constricted at the dissepiments, dense purplish violet; cells 3.8–5 μ long, protoplast homogeneous, apical wall convex, terminal wall in part slightly thickened; sheath 2–2.5 μ thick, hyaline, smooth, homogeneous.

Growing in a water reservoir at Rio Piedras, *no. 105,* type.

Lyngbya splendens sp. nov.

PLATE 9, FIGURE 81

Filaments forming a thin pannose stratum on the surface of the soil, long, relatively straight, gently arcuate, 17–20 μ diam.; trichomes 14–16 μ diam., not constricted; apices not attenuated; cells one-fourth to three-fourths as long as broad, uniformly and very finely granular, color aeruginous, cross-walls very thin but distinct; apical cell rounded, at times slightly narrower; terminal wall not thickened; sheath thin, smooth, homogeneous, hyaline at first, changing to salmon-pink.

Growing on tree trunks on the way towards Monte Montoro, Maricao, *no. 1072,* type.

Lyngbya splendens seems to be a very distinct species. The color of the sheath resembles that of some species of the genus *Porphyrosiphon,* but structurally it is more like a typical *Lyngbya* sheath. The trichomes are typical of the genus *Lyngbya.* It is probably closely related to *L. major.*

LYNGBYA EPIPHYTICA **aquaedulcis** var. nov.

Filaments adhering firmly to the filaments of the host; trichomes 0.8–1.2 μ diam.; cells quadrate or less, otherwise as the species.

Growing on the filaments of *Lyngbya majuscula* in a brook, San Lorenzo, *no. 494 a,* type.

The filaments of the variety are smaller and the cells shorter than those of the species, which is an inhabitant of salt water. The filaments at times completely encircled the host.

LYNGBYA MARTENSIANA **minor** var. nov.

PLATE 8, FIGURE 80

Filaments 250–500 μ long, moderately flexuous, 7.2–8 μ diam.; trichomes 4.8–5 μ diam., not constricted; bright blue-green; cells very short, 1.4–1.8 μ long, with fine granules along the cross-walls; apical cell capitate; tegument hyaline, homogeneous, smooth, about 2 μ thick.

Growing on limestone among other Myxophyceae between Hatillo and Arecibo, *no. 1392 b,* type.

Lyngbya intermedia sp. nov.

PLATE 9, FIGURE 82

Filaments long and more or less arcuate, 20–22 μ diam.; trichomes 17–20 μ diam.; cells 4.5–5.5 μ long, congested with granules away from the cross-walls, 1–2 apical cells attenuated, slightly thickened, or capitate; sheath hyaline, firm, smooth, not lamellose.

Growing in a pool among numerous other algae about four kilometers north of Mayagüez, *no. 1316 b,* type.

PORPHYROSIPHON NOTARISII **major** var. nov.

Filaments 22–28 μ diam.; trichomes 18–23 μ diam.; cells quadrate to one-third the diameter long, aeruginous; sheath relatively thin, homogeneous and hyaline when young, finally becoming thicker, pink, and somewhat lamellose when older.

Growing on rocks in the vicinity of Coamo Springs, *no. 6008,* type, collected by Dr. N. L. Britton; on soil along the road to San Lorenzo, *no. 523*; on soil north of Sabana Grande, *nos. 930, 931,* and *935 a.*

Porphyrosiphon robustus sp. nov.

PLATE 9, FIGURE 83

Filaments closely intertwined, forming a loose floccose stratum, of moderate length, 30–36 μ diam.; trichomes not constricted, neither attenuated nor capitate, 16–20 μ diam.; cells one-third to one-half as long as the diameter, homogeneous, bright aeruginous, cross-walls very distinct; apical cell rounded, wall not thickened; sheath rigid, at first hyaline, homogeneous, later changing to pale rose-pink and becoming decidedly lamellose, the ends usually extending much beyond the trichomes, and becoming collapsed and more or less lacerated.

Growing on rocks among moss, etc., about four kilometers north of Utuado, *no. 1570,* type; on red soil at Hacienda Holm, Mayagüez, *no. 1185 a.*

Phormidium calidum **olivaceum** var. nov.

Filaments scattered among other algae, not forming a definite stratum, relatively short, flexuous, 7–8 µ diam; trichomes 5.8–6.8 µ diam., straight at the apices and not attenuated, or 1–2 apical cells slightly attenuated and uncinate, capitate, frequently interrupted in the sheath; cells quadrate to one-third diam. long, homogeneous, dark olive-green or grayish green; sheath very thin, smooth, homogeneous, hyaline.

Growing on rocks among Hepaticae, and in association with other algae, about seven kilometers east of Coamo, *no. 1870 e,* type.

The above-diagnosed variety of *P. calidum* Gomont may be distinguished by the interrupted character of the trichome, which in some specimens is broken into numerous parts which gravitate some distance from each other, by the darker color, and by the less pronounced capitate apical cells.

Phormidium scytonematicola sp. nov.

Filaments short, crooked, forming a more or less compact layer on the filaments of the host, prostrate, with the ends free and more or less erect, 2.5–3 µ diam.; cells quadrate to 3 times as long, pale aeruginous, protoplast homogeneous; cross-walls inconspicuous; apices straight, blunt, not capitate; sheath very thin, inconspicuous.

Growing in depressions in rocks and on *Scytonema* at Hacienda Catalina, Palmer, *no. 747 a,* type; on rocks by the road north of Maricao, *no. 1252 a.*

This species of *Phormidium* is so abundant on some of the filaments of the host as to bind them into small symplocoid fascicles, and appears to restrict their growth.

Phormidium scytonematicola **minus** var. nov.

Trichomes 1–1.5 µ diam.; sheaths distinct, more or less confluent when densely aggregated, pale rose-pink in color.

Growing on rocks with *Scytonema* about ten kilometers north of Utuado, *no. 1565 a,* type.

Phormidium mucosum sp. nov.

PLATE 9, FIGURE 84

Filaments 7.2–7.8 μ diam., long, straight, or arcuate and smooth; trichome 2.5–3 μ diam., not constricted at the dissepiments, neither uncinate nor capitate; cells 2–2.5 times as long as the diameter, contents homogeneous, walls inconspicuous; apical cells rounded; end wall not thickened perceptibly more than the others; color pale aeruginous; sheath relatively thick, more or less gelatinous, hyaline, homogeneous.

Growing in a water basin in a garden in Humacao, *no. 641,* type.

The relatively thick and mucous or gelatinous sheath of *Phormidium mucosum* as proposed above, reminds one of certain narrow species of *Tolypothrix* and more particularly of certain species of *Hypheothrix.* It does not branch, and lacks the closed and acute apices characteristic of many species of the latter genus. It is apparently not abundant.

PHORMIDIUM LEPTODERMUM **capitatum** var. nov.

PLATE 9, FIGURE 85

Filaments forming a dense caespitose stratum, long and more or less flexuous, 6–6.5 μ diam.; trichomes pale aeruginous, 5–5.4 μ diam., slightly constricted at the dissepiments; apices straight, very slightly attenuated; cells quadrate to one-half the diameter long, homogeneous; cross-walls very thin and obscure; end cell slightly tapering, blunt; terminal wall thickened; sheath very thin, smooth, distinct, not diffluent.

Growing on rocks in a stream of warm water, Coamo Springs, *no. 364,* type.

The variety differs from the species chiefly in the possession of a thickened end cell wall.

Phormidium rubriterricola sp. nov.

PLATE 9, FIGURE 86

Trichomes 2.2–2.4 μ diam., short, not constricted, apices straight; cells quadrate to slightly longer or shorter, contents homogeneous, caerulescent to slightly drab-colored; apical cell blunt-conical; cross-walls very distinct; sheath hyaline, very thin, but distinct, not confluent.

Growing on red earth, Maricao, *no 1056,* type.

Phormidium calcicola sp. nov.

PLATE 9, FIGURE 87

Filaments forming a thick, tough stratum, densely encrusted with calcium carbonate, tortuous and intricately intertwined, 7–8 μ diam.; trichomes 5.8–6.4 μ diam., not constricted; apices not attenuated; cells quadrate, varying to slightly longer or shorter, contents homogeneous, pale aeruginous; cross-walls thin; end walls distinctly thickened, apical cell blunt, rounded; sheath thin, homogeneous, hyaline.

Growing in a waterfall, between Arecibo and Utuado, *no. 1460,* type.

The habit character of this species of *Phormidium* is very pronounced.

PHORMIDIUM INTERRUPTUM **rigidum** var. nov.

Filaments considerably tortuous, rigid; trichome 4.8–5.2 μ diam., not constricted; cells up to 2 times as long as broad; end cell rounded and end wall very slightly thickened, color very pale purplish-olive; sheath relatively thick, smooth, firm, hyaline to dark brown at maturity.

Growing on bark of trees, Coamo Springs, *no. 300 e,* type; and on the wall of a church, Sabana Grande, *no. 952;* on rocks near Coamo Springs, *no. 358 a.*

The variety *rigidum* differs from the species in having longer cells and a firm, rigid, brown sheath.

PHORMIDIUM INTERRUPTUM **capitatum** var. nov.

Trichomes 6.5–7.4 μ diam.; cells quadrate or longer; terminal cell rounded, capitate, otherwise as the species.

Growing in the vicinity of Humacao, *no. 540,* type.

The variety *capitatum* differs from the species only in the characters mentioned in the diagnosis. The trichomes are larger; the cells longer, and the end cell, at maturity, has a thickened terminal wall.

PHORMIDIUM AUTUMNALE **minus** var. nov.

Trichomes 3.6–4 μ diam., slightly tapering at the apices and slightly uncinate; cells quadrate to twice as long as broad; apical cell blunt-conical.

Growing among other algae in a water reservoir at the Experiment Station, Rio Piedras, *no. 203,* type.

This form marks the lowest limit of the species in diameter of the trichome. The cells average longer than in the species, and the apical cell is conical instead of rounded-capitate.

Growing in a waterfall between Arecibo and Utuado, *no. 1460,* type.

PHORMIDIUM PURPURASCENS **homogeneum** var. nov.

Filaments forming a thin, compact, pale-purplish stratum; trichomes 1.2–1.5 μ diam., pale purplish, not constricted; cells quadrate to one-half as long as the diameter, homogeneous; cross-walls distinct; apical cell blunt.

Growing on rocks in warm water flowing from Coamo Springs, *no. 367;* type.

The above-described form differs from the species in lacking granules at the cross-walls, in having the trichome smaller in diameter, and the cells shorter.

Phormidium durum sp. nov.

PLATE 9, FIGURE 88

Filaments aggregated into a loose, floccose stratum, long, flexuous, rigid; trichomes 12–14 μ diam., neither constricted at the dissepiments nor attenuated at the apices; cells quadrate to 2 times as long as the diameter, homogeneous to finely granular when old, pale purplish-gray; cross-walls thin but very distinct; apical cell rounded, not capitate; sheath hyaline, changing to reddish brown when old, homogeneous, smooth, rigid, 2–3 μ diam.

Growing in flocculent masses among moss on shaded rock near the Hacienda Catalina, near Palmer, *no. 746,* type; on weathered rock near Humacao, *no. 649.* This latter collection seems to belong to the same species as *no. 746* but is older and the sheath thicker.

This species is characterized by the long, smooth, rigid filaments, due to the nature of the sheath. The sheath seems to persist for some time after the death and decay of the trichome.

Plectonema spirale sp. nov.

Filaments attached at one end, erect and parallel, 125–150 μ long, variable in width at different periods of growth and in different parts of the filaments, when young tapering gradually towards the apices, later bulging in the middle and toward the base on account of the coiling and contortion of the trichomes, increasing the length of the diameter 2–3 times; trichomes 3–4 μ diam., tapering at the apices; cells quadrate to mostly one-half the diameter, long, pale aeruginous, homogeneous; cross-walls distinct below, obscure above; sheath very thin, about 0.5 μ diam., hyaline; branching simple or geminate.

Growing on an old pump, forming a dense velvety stratum, with other Myxophyceae, Maricao, *no. 1276 b,* type.

It was somewhat troublesome to place this species of *Plectonema.* The attached and erect habit is unusual in the small species, as are also the tapering filaments, although Gomont's description provides for that character. The plants are firmly attached at their bases by thin gelatinous walls, stand very closely together, and are chiefly parallel. In the lower half or quarter of the filament the trichome seems to begin to divide actively, and, not being able to push the upper part forward, begins to form a more or less regular to distorted spiral, at the same time the sheath enlarges instead of rupturing. Nearly the whole lower part of the trichome becomes thus transformed. The trichome also enlarges somewhat in diameter in the coiled part. Branching was observed to take place usually in the upper part of the coil or just above. Eventually the coiled portion of the trichome breaks into small segments, which become more or less spherical. Whether this is a natural process of decay or represents gonidia could not be ascertained. The sheath finally dissolves, but no evidence was at hand to indicate that the fragments of the trichome germinated to form new filaments. The presence of these bodies in the lower part of the erect tapering filaments suggests the genus *Leptochaete.* The gonidia in that genus, however, begin to form at the basal cells first, and no coiling of the filaments is known to occur. Again, *Leptochaete* does not branch. It seems best to place the specimen in the genus *Plectonema* as a new species, awaiting more knowledge of its life history.

In company with this species is an undescribed species of *Calothrix,* and a very slender filamentous species of another member of the Myxophyceae. The latter I forbear to place. The filaments are attached at one end and stand erect and parallel. They are about 1 μ in diameter. Possibly they represent the earlier stage of growth of *Plectonema spirale.*

Plectonema murale sp. nov.

PLATE 9, FIGURE 89

Filaments much contorted and geniculate, 3.6–4 μ diam., branching sparse; trichomes 1.5–1.8 μ diam., slightly constricted at the cross-walls, not attenuated at the apices; cells pale aeruginous, quadrate to 2 times as long as the diameter; apical cell blunt.

Growing on the wall of a bridge, Juan Martin, Fajardo, *no. 732 c,* type.

The material appears to have come nearly to the end of a period of growth as the branching is decidedly sparse, and most of the old connecting sheaths have disintegrated. The geniculate character of the filaments would indicate that branching was abundant, and more or less perpendicular to the main axis.

Plectonema flexuosum sp. nov.

PLATE 10, FIGURE 90

Filaments not forming a stratum, more or less scattered among other algae, 5.8–6.5 μ diam.; trichomes not constricted; apices not attenuated; cells quadrate to slightly longer than broad, homogeneous, aeruginous; cross-walls conspicuous; apical cells rounded to blunt-conical; sheath very thin, white, 0.5–0.8 μ diam.; branching single, moderately abundant.

Growing on soil in the woods, Coamo Springs, *no. 272 b,* type.

Plectonema tenuissimum sp. nov.

PLATE 10, FIGURE 91

Filaments prostrate or scattered among other filamentous algae, 1.4–1.6 μ diam.; trichomes slightly constricted at the dissepiments, especially at the meristematic ends, not attenuated; cells aeruginous, quadrate, cross-walls plainly visible; apical cells rounded; sheath scarcely discernible, except in the very oldest parts, hyaline; branching very sparse.

Growing on the wall of a house in Maricao, *no. 1049 b*, type.

Symploca Willei sp. nov.

PLATE 10, FIGURE 92

Filaments more or less flexuous, forming a thin, compact stratum, intricately intertwined, and at times forming definite funiculate strands; trichomes 3.5–3.7 μ diam., not constricted; apices straight, not attenuated; cells quadrate, varying to slightly shorter or longer, mostly free from granules, with a more or less definitely clear area in the center; pale aeruginous, tinged with yellow; cross-walls very thin, apical cell blunt to subconical; end wall rarely slightly thickened; sheath thin, distinct, hyaline, homogeneous.

Growing on earth in Utuado, *no. 1491*, type; on tree trunks, Coamo Springs, *no. 281 a.*

Symploca Willei, as represented by the specimen upon which it is founded, is hardly typical of the genus. The branching characteristic of the genus is not evident in the specimen. However, that is not an unusual condition. The typical, fasciculate habit of the genus is not well represented, although the filaments are sufficiently entwined into small funicular strands to relate it to the genus *Symploca,* but very close to the genus *Phormidium.*

Symploca symbiotica sp. nov.

PLATE 10, FIGURE 93

Filaments forming dense spindle-shaped fascicles by growing into the gelatinous tegument of the host, extending its entire length, and in many instances destroying it, moderately straight and parallel, up to 200 associated in a fascicle; trichomes pale aeruginous, tinged with yellow; neither constricted nor tapering at the apices, 0.6–0.8 μ diam.; cells 3–5 times as long as the diameter, homogeneous; sheath very thin and hyaline; not discernible when within the gelatinous tegument of the host.

Growing in association, for the most part within the sheath of *Microcoleus sociatus* G. S. West, on a wall in Fort San Cristobal, San Juan, *no. 2021 b,* type.

This very diminutive and decidedly unique member of the Myxophyceae presents important difficulties to one in attempting to classify it. Its position within the tegument of *Microcoleus* may be the determining factor in causing it to resemble *Symploca* in habit without having any real affinities with that genus. No branching was observed.

Symploca roseola sp. nov.

Filaments 2–2.5 µ diam., closely intertwined, forming dense, microscopic, conical fascicles; trichomes 1–1.3 µ diam.; cells quadrate to 2.5 times as long as the diameter; apical cell blunt, contents pale aeruginous, homogeneous, rose-pink.

Growing among other Myxophyceae on damp rocks about ten kilometers north of Utuado, *no. 1032 b,* type.

Hypheothrix acutissima sp. nov.

PLATE 10, FIGURE 94

Filaments not branched, more or less flexuous; trichomes sparse, 1–5, and closely associated in the sheath, 7–7.5 µ diam., short, rigid, straight for the most part; apices sharply attenuated for 7–10 cells, moderately constricted at the dissepiments; cells quadrate or slightly longer or shorter than the diameter, homogeneous, pale aeruginous, cross-walls thin but conspicuous; sheath thin, membranaceous, hyaline and homogeneous, close fitting.

Growing on moss along the way north of Maricao, *no. 1271 a,* type.

The material of this collection is sparse, but quite distinct.

The specimens upon which this species of *Hypheothrix* is founded are not typical of the genus in every particular. The sheath is thin and close-fitting, and when only a single trichome appears within a sheath, a condition of common occurrence, there is no way to distinguish it from the genus *Phormidium.* When several are closely entwined within a sheath it resembles some species of the genus *Microcoleus,* although typically that genus has a more ample sheath and more trichomes are associated within it. The size of the trichomes and their paucity within a sheath relate the species to those of the genus *Hydrocoleum* as founded by Kuetzing,[7] and as emended by Gomont.[8]

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[7] Phycologia generalis, 196. 1843.

[8] Monographie des Oscillariées. Ann. Sci. Nat. Bot. VII. **15**: 332. 1892.

The trichomes of *Hydrocoleum* are attenuated and capitate, as diagnosed by Gomont. In his original diagnosis of the genus *Hypheothrix,* Kuetzing (*loc. cit.,* 229) does not mention the character of the apices of the trichomes. The presence of two or more trichomes within a sheath according to Kirchner[9] led Gomont to reduce the genus to a subgenus of *Schizothrix.* But neither in his original description (Essai, 352. 1890) nor in his second publication of the subgenus[10] did he mention the character of the apices of the trichomes. Forti, in De Toni (Syll. Alg. **5**: 315. 1907), restores the subgenus to generic rank and emends it so as to include only those species with trichomes having straight, attenuated, and capitate apices. Accepting this limitation (purely arbitrary) of the genus would exclude the material under discussion from *Hypheothrix,* on account of its very acute apices. The only real distinction between the two genera, *Hypheothrix* and *Hydrocoleum,* as diagnosed by Forti (*loc. cit.*), seems to be that in the former the trichomes are not capitate and in the latter they are. The Porto Rican material conforms to the former in this, as well as in other characters, and I am placing it there as a very distinct species of the genus. The only species of the forty-three which Forti recognizes which approximates to it is *Hypheothrix pallida* (Naeg.) Kuetz. It differs from that species in the absence of an ample lamellose sheath, as well as in other minor details.

Hypheothrix longiarticulata sp. nov.

PLATE 10, FIGURE 95

Filaments prostrate, scattered among other Myxophyceae, 4.5–5.5 μ diam., moderately regular and smooth along the surface, more or less branched near the ends; trichomes mostly single, occasionally two in a sheath, 1.7–2 μ diam., not constricted; cells 8–12.5 μ long, homogeneous; apical cell conical; sheath homogeneous, white.

Growing on a wall in Fort San Cristobal, San Juan, *no. 2022 a,* type.

Hypheothrix parciramosa sp. nov.

PLATE 10, FIGURE 96

Filaments loosely adhering into erect, subparallel, spinulose fascicles 3–4 mm. high, branched near the base, producing long, cylindrical branches with acute apices, 10–15 μ thick; trichomes single within a sheath, or in the region of branching at times with 2–3 in a sheath, 4.5–5 μ diam., deeply constricted at the cross-walls, pale aeruginous to grayish; cells quadrate to 2 times as long as the diameter; homogeneous, finely or coarsely granular, according to age; apical cells blunt-conical; sheaths hyaline, homogeneous, or slightly lamellose in some old filaments.

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[9] Engler & Prantl, Naturl. Pflanzenfam. 1[1a]: 67. 1898.

[10] Ann. Sci. Nat. Bot. VII. **15**: 306. 1892.

Growing among moss at "Campo" in Mariaco, *no. 1228*, type.

The combination of characters in these plants, as diagnosed above, is such as to exclude it from any of the previously described genera. It then becomes a matter of either creating a new genus, modifying the already recognized ones, or waiving some of the characters. I have decided to do the last, and place it with *Hypheothrix*, with the fasciculate habit.

Hypheothrix symplocoides sp. nov.

PLATE 10, FIGURE 97

Filaments 8–10 μ diam., prostrate and free at the base, growing erect and coalescing firmly into acute conical fascicles, seemingly many trichomes in a common sheath, but the individual filaments containing but a single trichome, very distinct below, and in part remaining completely distinct throughout; fascicles about 1 mm. high; trichomes 2.4–2.8 μ diam., not constricted at the cross-walls; cells 1.5–3 times as long as the diameter, bright aeruginous, homogeneous to finely granular; sheath hyaline, almost transparent, smooth, homogeneous.

Growing on the soil in a forest near Hacienda Catalina, Palmer, *no. 760*, type, and *no. 754*.

The material of this species possesses the characters closely relating it to at least four established genera. Its size, color and especially its fasciculate habit of growth, are typical of the genus *Symploca* Kuetz. but the sheaths are too much thickened to be characteristic of that genus and the characteristic branching is lacking. Nothing would prevent its alliance with Gomont's genus *Symplocastrum*, but its lack of multiple trichomes within a common sheath excludes it from that genus as emended by Kirchner.[11] It is a typical *Schizothrix* in the sense of Forti[12] with the exception of the color of the sheaths, and in the sense of

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[11] Engler & Prantl, Naturl. Pflanzenfam. **1**^{1a}: 69. 1898.

[12] In De Toni, Sylloge Algarum **5**: 359. 1907.

Kirchner (*loc. cit.,* 60), with the same exception, and in additional exception of the lack of multiple trichomes in a common sheath. They become confluent by fusion after formation of the separate sheaths. It is typical *Hypheothrix* with the exception of the symplocoid habit, a condition which varies considerably with the environment. I am placing it in the last-mentioned genus, awaiting further knowledge of its life history.

Hypheothrix Willei sp. nov.

PLATE 10, FIGURE 98

Filaments prostrate, distributed among other algae, about one-half mm. long, 40–60 μ diam., more or less irregularly branched, fairly definite and smooth on the surface; trichomes 1–3 in a sheath, 5.2–5.4 μ diam., straight, not constricted, long and sharply attenuated at the apices; cells quadrate to slightly greater or less than the diameter, pale aeruginous, densely congested with relatively large granules evenly distributed; cross-walls very thin; 4–6 apical cells forming an acute cone; sheath hyaline in the juvenile stage, changing with age in part to light pink or salmon, homogeneous.

Growing among other *Myxophyceae* on rocks west of Humacao, *no. 613 b,* type.

In placing this species I have weighed the slight coloration of the sheaths against other characters and decided to place it with *Hypheothrix,* although that genus has been limited to include only those forms with hyaline sheaths.

Schizothrix violacea sp. nov.

PLATE 11, FIGURE 99

Filaments not forming a definite stratum, but associated with other algae, 400–600 μ long, 7–11 μ diam., contorted, usually collected into small groups and more or less adhering to each other, but frequently single and independent, tapering at the apices to a sharp point, unbranched; trichomes single in a sheath, cylindrical, 2.3–2.5 μ diam., very slightly constricted at the dissepiments; cells quadrate to twice as long as the diamter, homogeneous, pale olive-green; cross-walls very thin; end cell blunt-conical; sheath ample, dark violet, homogeneous, somewhat roughened on the margin.

Growing among other Myxophyceae on limestone between Arecibo and Utuado, *no. 1476 g,* type.

Schizothrix mellea sp. nov.

Filaments associated with other algae, prostrate to somewhat erect, and at times slightly fasciculate, 400–800 μ long, 8–15 μ diam., moderately and alternately branched; apices acuminate, closed; trichomes 1–3, or as many as 6, within a sheath, 3.3–3.6 μ diam., straight or arcuate, with the filaments not congested, slightly constricted at the cross-walls; cells 2–2.5 times as long as broad, homogeneous to finely granular, pale aeruginous to slightly honey-colored; cross-walls thin, but conspicuous; apical cell blunt-conical; sheath homogeneous, hyaline, but soon changing to dense honey-color.

Growing on red soil by the road to Hacienda Catalina, Palmer, *no. 776 a,* type, and *no. 778 a*; on rocks at Maricao, *nos. 1031 a, 1033 a, 1037 c,* and *1043 a*; on soil by the road to Monte Montoro, Maricao, *nos. 1071 c* and *1077 d*; on rocks near Maricao, *no. 1142*; on earth at Hacienda Holm, Mayagüez, *nos. 1177 a* and *1179 a.*

Schizothrix mellea, as proposed here, is very close in the structure of the trichome to *Schizothrix* (*Symplocastrum*) *Friesii* as described by Gomont,[13] but it is much smaller (less than one millimeter long) than that species, and lacks the rigid, erect, spine-like habit which that species generally, though not always, assumes.

SCHIZOTHRIX MELLEA **minor** var. nov.

Trichomes 2.2–2.4 μ diam.; filaments shorter than in the species, otherwise the same as the species.

Growing on rocks, Maricao, *no. 1032 a,* type; Arroyo de los Corchos, *no. 1732.*

Schizothrix rosea sp. nov.

Filaments long and flexuous, remaining simple and with a single trichome for some time, later with two trichomes, and more or less branched; trichomes 6–6.2 μ diam.; sheath narrow and homogeneous, hyaline at first, changing to pale purplish pink, becoming thicker and more or less lamellose at maturity.

Growing on rocks in the vicinity of San Lorenzo, *no. 519,* type; on earth, Hacienda Holm, Mayagüez, *no. 1176.*

SCHIZOTHRIX THELEPHOROIDES **minor** var. nov.

Filaments 300–400 μ long, alternately and somewhat profusely branched, 15–20 μ diam., not forming a definite stratum, but more or less scattered, tapering to blunt apices; trichomes 1–3 in a sheath, pale aeruginous, slightly constricted at the cross-walls, 2.4–2.8 μ diam.; cells quadrate to two times as long as the diameter, finely granular, apical cell blunt-conical; sheath 2–3 times as thick as the trichome, rose-pink in color.

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[13] Gomont, Ann. Sci. Nat. Bot. VII. **15**: 316. 1892.

Growing on red earth, Mayagüez, *no. 880 c,* type.

MICROCOLEUS SOCIATUS **minor** var. nov.

Filaments more or less intertwined into small fascicles, 1–1.5 cm. long, erect or mostly prostrate, forming a loose pannose stratum; trichomes single within a sheath, 2.4–2.7 μ diam., yellowish green, apical cell acute-conical.

Habitat unknown; specimen in the Herbarium of The New York Botanical Garden, collected in the Luquillo Mountains, Porto Rico, and determined by Hauck as *Scytonema thelephoroides* Mont.

The variety *minor* differs from the species in being longer, in having smaller trichomes, and acute-conical apical cells.

Inactis ecalcarea sp. nov.

PLATE 11, FIGURE 100

Filaments standing parallel and erect, forming with *Calothrix* a velvety stratum; trichomes 0.9–1.1 μ diam., 1–4 in a sheath, straight, not tapering, not constricted at the dissepiments; cells quadrate, pale, aeruginous; cross-walls very thin; apical cell blunt; sheath very obscure.

Growing on stones in the Turabo River, near Caguas, *no. 481 a,* type.

The material used as the basis of this species is clean and in good condition, and free from lime, the presence of which is rather common in the genus.

LYNGBYOPSIS gen. nov.

Filaments prostrate, composed of one or more multicellular trichomes, each developing its individual sheath; false branching in either or in both directions towards the ends of the longitudinal axis; sheath firm and membranaceous.

The genus *Lyngbyopsis,* as proposed here, seems most closely related to the genus *Hypheothrix.* It is to be distinguished by its method of branching combined with the character of the sheath. In *Hypheothrix* and closely related genera, the plants are, as a rule, oriented into a basal and an apical part. In this respect *Lyngbyopsis* is more closely related to such genera as *Lyngbya* and *Phormidium,* in which the trichomes are not oriented into apical and basal portions, the whole trichome being meristematic. The multiplication of trichomes within a sheath is brought about in *Lyngbyopsis* by the formation of hormogonia as in *Lyngbya* and in related genera by the death of certain cells. Upon elongation of the hormogonia in both directions the ends meet, and, instead of the sheath dissolving and liberating the trichomes, it remains intact; and, instead of the ends of the trichomes, or hormogonia, crawling or pushing each other out of the sheath, the sheath seemingly stretches and encloses them both. Repetition of the process in the same part of the filament results, at times, in several trichomes being enclosed within the same sheaths; sooner or later one or more trichomes break through the sheath, forming a false branch. Either or both ends of a trichome may push through the sheath, so that the branches may arise anywhere along the filament, and extend in opposite directions. The branches, while yet attached to the parent filament, repeat the process, resulting in a tangle of several generations of attached filaments. But a single species appears in Wille's collections and I am dedicating that to him.

Lyngbyopsis Willei sp. nov.

PLATE 11, FIGURE 1

Filaments 4–6 mm. long, variable in diameter, forming a flocculent stratum, composed of 1–6 trichomes, branching fairly abundant; trichomes smooth or in part slightly constricted at the cross-walls towards the apices, 5.8–6.2 μ diam.; cells quadrate to one third as long as the diameter, pale aeruginous, homogeneous; apical cell blunt, rounded, with slightly thickened terminal wall; sheaths firm, smooth, hyaline, homogeneous, 1–2 μ thick.

Growing on rocks in a brook about five kilometers north of Utuado, *no. 1597,* type.

Microcoleus acutissimus sp. nov.

PLATE 11, FIGURE 2

Filaments small and relatively straight, 400–550 μ long, 20–35 μ diam., containing 15–30 trichomes, closed at the conical tips when young, later opened and the trichomes extruding; trichomes straight, almost parallel in the sheath, not constricted at the cross-walls, long and very sharply acuminate at the apices; 1.8–2.2 μ diam.; cells pale aeruginous, homogeneous, 2–4 times as long as the diam.; apical cell longer and very sharp, conical; cross-walls obscure; sheath hyaline, irregular along the margin, somewhat mucous.

Growing on a church wall, Sabana Grande, *no. 952 d,* type; on the soil, between Hatillo and Arecibo, *no. 1366 b*; on a wall in Fort San Cristobal, San Juan, *no. 1991 e.*

The nearest approach in relationship to this species of *Microcoleus,* so far as is known, seems to be *M. tenerrimus* Gomont, a salt-water species. The plants of that species are larger, of a deeper color, and especially not so long and sharply attenuated at the apices.

Microcoleus amplus sp. nov.

PLATE 11, FIGURE 3

Filaments tortuous, mostly open at the apices with extruding trichomes, smaller, younger ones closed; 30–60 trichomes densely entwined in the center of the filaments, 4.6–5 μ diam., very bright blue-green in color, 2–3 cells attenuated at the apices, not constricted at the dissepiments; cells quadrate to twice as long as broad, densely congested with fine irregular granules; cross-walls very distinct; apical cell conical; sheath white, smooth, homogeneous, ample, 9–12 μ thick.

Growing on mud by a stream near Rio Piedras, *no. 72,* type; on earth at the Experiment Station, Rio Piedras, *no. 179*; on earth, Utuado, *nos. 1505* and *1573.*

Microcoleus amplus has close affinities with *M. vaginatus* Gomont, *M. paludosus* Gomont, and *M. lacustris* Farlow. From the first it differs in not having capitate trichomes and in having longer cells; from the second in having smaller trichomes and shorter cells; and from the last in not having constricted or dolioform cells, and in having more acute apices. It differs from all three in having a more ample sheath.

Microcoleus purpureus sp. nov.

PLATE 11, FIGURE 4

Filaments 15–25 μ (up to 50 μ) thick, acuminate, scattered promiscuously among other algae, more or less contorted, closed at the apices when young, dissolving, and the trichomes protruding at the apices when older, with the trichomes crowded close to each other in the center and more or less intertwined but finally separating into separate strands and forming new filaments; trichomes up to 60 or more within a sheath, mostly parallel, 1.7–1.9 μ diam., pale purplish-drab, not constricted, with acute and in part uncinate apices; cells homogeneous, 3–4 times as long as the diam.; sheath hyaline, homogeneous, somewhat gelatinous and irregular along the margin.

Growing on a wall in Fort San Cristobal, San Juan, *no. 1991 d,* type; on a wall in a cemetery, San Juan, *no. 130 a.*

MICROCOLEUS PALUDOSUS **acuminatus** var. nov.

PLATE 11, FIGURE 5

Trichomes few in a sheath, 5–6 μ diam., pale aeruginous, 3–5 cells at the apices tapering to a very sharp point, and in part slightly uncinate.

Growing on a wall in Fort San Cristobal, San Juan, *no. 2013 a,* type.

The material of this species is very sparse, only a few filaments having been observed and those growing among a very small species of moss.

MICROCOLEUS SOCIATUS **minor** var. nov.

PLATE 11, FIGURE 6

Trichomes up to 75 in a sheath, 1.8–2.5 μ diam., not constricted, pale aeruginous changing to yellowish green on drying; cells homogeneous.

Growing on limestone among other algae between Hatillo and Arecibo, *no. 1392 a,* type; on a wall in an old cemetery, San Juan, *no. 130 b*; in a water reservoir, west of the Experiment Station, Rio Piedras, *no. 200*; on a wall, Coamo Springs, *no. 254 b*; on a wall by a bridge to Santurce, *no. 143 b*; on the wall of a church, Sabana Grande, *no. 952 b*; on a wall in Fort San Cristobal, San Juan, *nos. 2006 a, 2020 a,* and *2021 c.*

Hydrocoleum rufescens sp. nov.

Filaments containing 1–5 trichomes, mostly straight, or somewhat tortuous, smooth, unbranched, narrow, spindle-form, closed at the apices when young, later the ends dissolving and the trichomes extruding; trichomes nearly parallel, separated from each other for the most part, moderately constricted at the dissepiments, acuminate at the apices; cells homogeneous, pale to bright aeruginous; cross-walls very thin; apical cell blunt-conical, with a very small calyptra; sheath ample, hyaline when young, changing to pinkish red at maturity, homogeneous.

Growing on clay soil among other Myxophyceae, together forming a very thin, compact stratum, Experiment Station, Mayagüez, *no. 972,* type.

The organism described here is one of many in the collection which hover around the generic borders. The filaments are small for the genus *Hydrocoleum* and lack the characteristic well-developed calyptra or thickened end wall of the typical species of that genus. Its colored sheath and small number of trichomes within a sheath do not well coincide with typical members of the genus *Microcoleus.* Its unbranched filaments combined with its colored sheath and prostrate habit do not unmistakably ally it with any of the *Schizothrix* group.

The material is mature and most of the trichomes separated more or less into hormogonia, hence characteristic attenuated and capitate ends are very sparse.

Anabaena lutea sp. nov.

PLATE 12, FIGURE 7

Trichomes densely aggregated, moderately straight, 4.8–5.2 μ diam., deeply constricted; cells subcylindrical to dolioform, about 2 times as long as the diameter, homogeneous, pale drab to amber-colored, forming microscopic colonies irregular in shape and size, but mostly membranaceous; heterocysts spherical, subspherical to dolioform; 6.5–7.5 μ diam; spores dolioform to broadly ellipsoidal, 7–8 μ diam., 12–15 μ long, wall smooth, 10–15-catenate; tegument yellowish or amber-colored at maturity, moderately firm.

Growing on earth about five kilometers south of Adjuntas, *no. 1665,* type; in a small stream about five kilometers east of Coamo, *no. 237 c.*

It is somewhat difficult to determine the generic position of the organisms described above. It is not unlike some of the more or less foliaceous species of *Nostoc,* forming colonies with a definite outline. The trichomes are relatively straight and short, and the gelatinous matrix is not very firm, conditions commonly met with in *Anabaena*. Knowledge of the developmental stages may shed light upon the subject of its generic position. It belongs to the *Dolichospermum* section of the genus, having affinities with *A. inaequalis* (Kuetz.) Born. & Flah. It differs from that species in being smaller in all of its measurements.

Anabaena unispora sp. nov.

Plate 12, figure 8

Stratum thin, slightly mucous, or trichomes intermixed with other algae; trichomes short, for the most part straight, slightly attenuated for several cells; cells cylindrical, slightly constricted at the dissepiments, 4–4.5 μ diam., 1.5–2 times as long as the diameter, containing few to many small granules; terminal cells blunt, heterocysts slightly larger in both dimensions than the cells, one, or rarely two, in a trichome; spores single, developing at one side of the heterocyst, narrowly to broadly ellipsoidal, variable in size, 20–34 μ long, 13–20 μ broad, with a smooth thin hyaline membrane, or at times the inner layer slightly brownish in color.

Growing in a pool among other algae and débris near the Park, Santurce, *no. 49 a,* type, *no. 44 c,* and *no. 51 d.*

The very conspicuous character of this species of *Anabaena* is the production of a single resting spore by each plant. The large majority of plants produce but a single heterocyst, although there are occasionally two in a plant. In case there are two usually one is located near the end of the trichome and the other near the center in its characteristic position. However, no plants were seen with more than one spore. In number 47 c of the collection, and in scattered filaments in several other collections, the plants are young and the spores are sparse, but in number 51 d the material is thoroughly mature and the spores are numerous. It is difficult to ascertain its nearest relatives.

Anabaena subtropica sp. nov.

Plate 12, figure 9

Trichomes relatively straight and short, deeply constricted at the dissepiments, 3.5–4.5 μ diam.; cells subcylindrical, approximately quadrate, pale aeruginous to slightly purplish in mass; apical cells blunt, rounded, sometimes smaller than others; heterocysts spherical to subspherical, 5.2–6 μ diam.; spores spherical to slightly longer in part, wall hyaline or somewhat discolored at maturity, smooth, seriate, or discontinuous, developing toward the heterocysts, 5–6.4 μ diam., 6–7.5 μ long.

Aggregated into small masses or free; among other algae in a stream about five kilometers east of Coamo, *no. 235 b,* type.

Two other species of *Anabaena* were found associated with this one, both, however, sterile, and I have not classified them.

Anabaena Willei sp. nov.

PLATE 12, FIGURE 10

Trichomes bright aeruginous, long, relatively straight, deeply constricted at the dissepiments, 4.8–5.2 μ diam., attenuated at the apices; cells short, mostly quadrate, cylindrical, finely granular; apical cell conical; heterocysts cylindrical or somewhat dolioform, 5–6 μ diam., 9–12 μ long, hyaline; spores cylindrical, 6.5–8.6 μ diam., 15–20 μ long, smooth, outer layer slightly brown in color, densely granular, bright blue-green, 2 3-catenate next to the heterocysts.

Growing in a pool among other algae, Jayuya, *no. 1750,* type; in a ditch, Ponce, *no. 1670 a*; in a small stream about five kilometers east of Coamo, *no. 237.*

Anabaena Willei belongs to the Sphaerozyga section of the genus, as limited by Agardh (Aufzaehlung, 634, 1827) and is related to *A. oscillarioides.*

Anabaena aeruginosa sp. nov.

PLATE 12, FIGURE 11

Trichomes relatively short and straight, aggregated into small masses or free-floating, 3.2–4 μ diam., not attenuated; cells bright aeruginous, subspherical, seemingly loosely attached to each other; apical cell blunt-rounded; heterocysts like the cells in form, 5–6 μ diam.; spores broadly dolioform, 2–4-catenate between the heterocysts, about 10 μ diam. and 15 μ long, contents densely and coarsely granular, bright aeruginous, walls smooth, hyaline.

Growing in company with *Anabaena Willei* and other algae about five kilometers east of Coamo, *no. 237 b,* type.

This species of *Anabaena* belongs in the Dolichospermum section of the group, proposed by Ralfs (Nostoch. 325, 1850) but has straight spores instead of curved ones, characteristic of most of the species of the section. Its closest affinity seems to be *A. oblonga* De Wilden.

Anabaena epiphytica sp. nov.

Trichomes epiphytic, firmly attached, few at first, mostly parallel and contiguous, extending lengthwise of the host, later completely surrounding it and in places becoming more than one layer deep, brought about by secondary growth of intercalary cells; cells subspherical, 5–5.3 μ diam., usually less than the diameter in length; heterocysts spherical or compressed-spherical, 6–6.3 μ diam.; spores unknown.

Growing on other filamentous algae in a pool near the Experiment Station, Rio Piedras, *no. 1947,* type, *no. 154 b,* and *no. 1946 a.*

Unfortunately the complete life history of this species of *Anabaena* cannot be given at this time, the material having no resting spores. The size and structure of the trichomes, combined with the habitat (growing firmly attached to other plants, *e.g., Oedogonium* in the case of *no. 1947*) seem to warrant giving the material specific rank.

Anabaena delicatissima sp. nov.

Plate 12, figure 12

Trichomes short, straight, free-floating, tegument inconspicuous, transparent, 2.3–2.5 μ diam., deeply constricted at the dissepiments; apices blunt; cells compressed-spherical, about two-thirds as long as the diameter; heterocysts spherical, slightly larger than the cells; spores unknown.

Floating or attached to water-inhabiting plants among nunerous other species of Myxophyceae. Collected by Dr. W. C. Earle in the vicinity of Manati, Porto Rico, in 1925.

Although it is not generally advisable to identify species of *Anabaena* without spores, the very small size of the vegetative parts of the above species makes it appear to be wholly distinct from any known species of the genus.

Anabaena mediocris sp. nov.

Plate 12, figure 13

Trichomes relatively straight; cells cylindrical to slightly dolioform, deeply constricted, 4–4.5 μ diam., 1–2 times as long as the diameter, terminal cell conical; heterocysts dolioform, 5 μ diam., 8–10 μ long; spores single or in pairs, and contiguous to the heterocysts on both sides, ellipsoidal, about 10 μ diam. and 20 μ long, with smooth hyaline walls.

Growing in a ditch near Mayagüez, *no. 1004,* type; on plants in a pool between Hatillo and Arecibo, *no. 1355.*

Anabaena portoricensis sp. nov.

PLATE 12, FIGURE 14

Trichomes 7–8 μ diam.; cells dolioform to compressed-spherical, pale aeruginous; apical cells subspherical to blunt-conical, usually smaller than the others of the trichome; heterocysts spherical, 10 μ diam.; spores broadly ellipsoidal, 10 μ diam., about 15 μ long, contiguous to the heterocysts.

Growing in a ditch near Ponce, *no. 1670 b,* type.

Nostoc Willei sp. nov.

Thallus iregular in shape and size, firm, gelatinous, 1–4 mm. diam.; trichomes moderately contorted; cells cylindrical to slightly dolioform, 3.7–4 μ diam., slightly constricted at the dissepiments, up to 18 μ long, densely and finely granular; heterocysts spherical, 5–5.5 μ diam., smooth and hyaline; teguments hyaline; resting spores subcylindrical to ellipsoidal, 14–20 μ long, 7–9 μ broad, with a smooth hyaline membrane.

Growing among moss on trunks of trees at Coamo Springs, *no. 267,* type.

This species of *Nostoc* belongs to the Humifusa section of the genus created by Bornet and Flahault and is related in the trichome characters to *N. ellipsosporum* (Desm.) Rab.

Nostoc Brittonii sp. nov.

Thallus spherical, up to 2 mm. diam., firm, smooth; trichomes very tortuous, moderately crowded, 3.6–4.8 μ diam.; cells dolioform to subspherical, bright violet or drab, fading to greenish; heterocysts spherical, single in the juvenile stage of the trichome, later, on the formation of hormogonia, two or more are formed, these usually being somewhat smaller; tegument opalescent when young, changing to purplish drab, and finally to yellowish brown; resting spores unknown.

At "Campo" south of Maricao, collected by Dr. N. L. Britton, *no. 1290 a,* type; collected by Dr. Wille in the same locality, *no. 1229 c.*

No resting spores have been observed in the material of this species of *Nostoc.* Some of the colonies, however, are mature and have formed hormogonia with definite individual teguments showing the beginning of new colonies. After having been dried, the color seems to diffuse out of the trichomes into the tegument when wet.

Nostoc album sp. nov.

Thallus spherical, up to 500 μ diam., very smooth on the surface; trichomes tortuous, but not congested, bright olive-green to violet; cells subspherical or dolioform, very finely granular; heterocysts spherical, 6–7.4 μ diam., single, fairly abundant; tegument almost transparent, firm.

Growing among moss near a stream in the vicinity of Maricao, *no. 1149,* type.

It is possible that the above-described new species of *Nostoc* may be the juvenile stage of another species. The colonies are in all stages of development from short filaments with only a few cells to colonies up to one-half millimeter in diameter. There is considerable indication that the largest colonies are nearing maturity, as some of them show the formation of hormogonia. I was unable to discover any resting cells, but the fact that among the numerous very young colonies there is no indication that any of them originated from resting cells leads me to conclude that possibly there is no formation of single resting cells and that reproduction takes place only by formation of hormogonia.

More observations on the life history of the organism will be necessary to establish its specific status.

Nostoc simulans sp. nov.

Thallus of no definite shape, more or less confluent, soft and gelatinous; trichomes moderately tortuous, constricted at the dissepiments, 2.4–2.6 μ diam., 1.5–2 times as long as the diameter; heterocysts spherical, about 3 μ diam., resting spores cylindrical to ellipsoidal, 3.8–4.2 μ diam., 6.8–7.5 μ long, walls smooth, hyaline.

Growing in cavities in the wall of a house in Maricao, *no. 1117,* type.

The species proposed here belongs to the section Humifusa of Bornet and Flahault, as a close relative in all appearances tc *N. humifusum* Carmichael.

Nostoc membranaceum sp. nov.

Thallus in the juvenile stage more or less spherical and solid, soon becoming hollow, still later becoming much lacerated and expanding into thin, membranaceous, somewhat papery, strata 5–8 cm. across, 100–125 μ thick; trichomes tortuous, densly packed together; cells spherical to compressed-spherical, 4.6–5.2 μ diam., pale aeruginous, almost homogeneous, but at times containing a few small granules; heterocysts spherical, 5.8–6.4 μ diam., very numerous; tegument firm, smooth on the outside, hyaline or changing to yellowish brown with age; resting spores unknown.

Growing on sand rock along the shore of the Rio Grande, near Sabana Grande, *no. 942,* type; on a water pipe near a stream in the vicinity of Maricao, *no. 1147.*

Nostoc sphaerosporum sp. nov.

Thallus spherical or in part irregular in form when young, becoming more irregular with age; up to 600 μ diam.; trichomes moderately flexuous and intricate, not densely crowded, becoming straighter when spore formation begins, 3–3.6 μ diam., pale aeruginous; heterocysts spherical, 6–6.5 μ diam., hyaline; spores spherical, 4.7–5.5 μ diam., smooth, hyaline; tegument dirty white, moderately firm.

Growing on bark among other Myxophyceae near Utuado, *no. 1506 a,* type.

The diminutive size of the colonies coupled with the spherical spores, heterocysts, and cells, constitute a combination of characters distinctive of this species.

Nostoc ellipsoideum sp. nov.

Thallus without definite form, usually flattened and irregular, firm-gelatinous or cartilaginous up to 3 mm. diam.; trichomes moderately tortuous, not densely congested, pale aeruginous, deeply constricted at the dissepiments; cells cylindrical to narrowly ellipsoidal, 1.4–1.8 μ diam., quadrate to 2.2 times as long as the diameter, homogeneous; heterocysts dolioform, 2.4–2.8 μ diam.; spores ellipsoidal, about 3 μ diam., about 6 μ long; tegument opalescent, changing to yellowish brown at maturity.

Growing on rocks in the vicinity of Jayuya, *no. 1797,* type.

Nostoc ellipsoideum appears to have its nearest affinities in Humifusa section of the genus. The spores seem not to be quite mature.

Nodularia Willei sp. nov.

PLATE 12, FIGURE 15

Filaments 9–10.5 μ diam., straight, short; trichomes 8.4–8.8 μ diam.; cells disk-shaped or very much compressed spheres; 3.8–4.5 μ long, contents finely granular, aeruginous; heterocysts subspherical to compressed-spherical, slightly larger than the cells, with hyaline walls changing to pale amber; spores seriate between the heterocysts, 9.5–10 μ diam. densely granular, walls hyaline, changing to brown at maturity, very thin and smooth; sheath almost transparent, soft gelatinous.

Growing in a pool near Laguna Guanica, *no. 1817 a,* type.

Nodularia epiphytica sp. nov.

PLATE 12, FIGURE 16

Filaments aggregated into small masses or scattered more or less upon the host; mostly relatively straight but in part curved, 60–125 μ long, 4.7–5 μ diam.; trichomes 3–3.8 μ diam.; cells bright aeruginous, homogeneous, in part showing a clear central area, about one-half the diameter long, deeply constricted at dissepiments, making them short-dolioform; apical cell subspherical; heterocysts of the same shape and size as the cells, or in part larger, sparse, at times 2–3-seriate; sheath very nearly transparent, thin; spores unknown.

Growing on a very small species of Hepaticae on limestone, Hato Arriba, Arecibo, *no. 1415 a,* type; Coamo Springs, *no. 282 d.*

It is unfortunate that the material is not producing resting spores so that the whole life history might be given of this very diminutive, though distinct, species of *Nodularia.* It apparently is closely related to *N. Harveyana* (Thwaites) Thuret, but has much shorter cells.

Leptochaete tenella sp. nov.

PLATE 12, FIGURE 17

Filaments erect, closely crowded together, 80–150 μ long, 1.5–2.2 μ at the base, tapering very gradually toward the apex, forming a very thin continuous stratum; trichomes 1–1.4 μ diam. at the base, tapering to an exceedingly narrow hair above; cells quadrate or less; gonidia free at the base, mostly uniseriate.

Growing on stones in a stream near Maricao, *no. 1128,* type.

The plants mostly appear to be young in this species of *Leptochaete* as represented by the specimens in the collection, but seem unmistakably to be a distinct species.

Calothrix conica sp. nov.

PLATE 13, FIGURE 18

Filaments only very slightly swollen at the base, branching very sparse, up to 125 µ long, but mostly 45–65 µ long, 6.8–7.5 µ diam. at the base, straight or in part more or less curved, almost equidiametric throughout the entire length; trichomes 4.8–5.6 µ diam., 1–3 cells slightly larger at the base, and 1–3 cells attenuated at the apices; apical cell conical; no indication of any hair cells; cells cylindrical below, decidedly dolioform above, quadrate below to slightly shorter above, aeruginous, homogeneous; heterocysts spherical to subspherical, single, basal, conspicuous; sheath hyaline, thin and close-fitting, ephemeral; hormogonia short.

Growing on trees in a ravine near Coamo Springs, *no. 1895,* type.

Calothrix conica is apparently related to *C. tenella* of this paper and to *C. epiphytica* W. & G. S. West. It is to be distinguished by the conical apices, almost cylindrical trichomes, dolioform, almost moniliform cells in the upper part of the trichomes and by the delicate hyaline ephemeral sheath. There is no indication of hairs. They may appear, however, in the early stage of the development of trichomes.

Calothrix simplex sp. nov.

PLATE 13, FIGURE 19

Filaments 200–250 µ long, attached at the base, erect and straight or a few curved close to the base and erect, forming a continuous stratum with other Myxophyceae, tapering gradually and uniformly from the basal cell to the long apical hair, or in some of the oldest filaments, 2–4 basal cells somewhat larger, making a slight bulbous base, up to 18 µ diam. at the base 2–2.5 µ at the apex; trichomes 10–14 µ diam. at the base, aeruginous, not constricted at the dissepiments; cells one-third to one-fourth the diameter long, homogeneous; heterocysts single, all basal, hemispherical to elongated, hyaline; sheath thin, firm, smooth, homogeneous, hyaline; reproduction by small hormogonia formed in the upper part of the filament.

Growing in a stream on stones in the vicinity of San Lorenzo, *no. 501,* type; in a pool about four kilometers north of Mayagüez, *no. 1327 c*; on stones in the Turabo River near Caguas, *no. 481.*

The material of this collection is very clean and in excellent condition. Apparently every stage in the development is represented. There are many small hormogonia down at the base of the mature specimens. Between these small specimens and the old mature ones there are many gradations in size represented. The species is associated with *Lyngbya erecta,* a species attached at one end and the filaments erect and parallel. Together these form a compact, velvety stratum on stones.

Calothrix tenella sp. nov.

PLATE 13, FIGURE 20

Filaments 60–90 μ long, mostly tortuous, 10–12 μ at the base, somewhat swollen above the base, tapering to a slender hair; trichome 4.8–6.2 μ at the base; cells quadrate to one-half as long as the diameter, homogeneous; pale aeruginous to yellowish green; heterocysts basal, spherical to subspherical, usually smaller than the trichome in diameter; sheath smooth, hyaline, thicker above the base.

Growing on and among Hepaticae on rocks, near Maricao, *no. 1036 a,* type.

Calothrix epiphytica W. & G. S. West is probably the nearest relative to the above species among all of the known species of the genus. *C. tenella* is a much shorter species with a more ample sheath.

CALOTHRIX PARIETINA **torulosa** var. nov.

Filaments 400–700 μ long, rigid, straight or in part with moderate curves; trichomes olive-green, decidedly torulose in the lower part; sheath narrow, firm and homogeneous, becoming slightly lamellose and in part thickened later; a few of them slightly ocreate, and yellowish-brown.

In Rio Grande, near Sabana Grande, *no. 914,* type.

CALOTHRIX BRAUNII **contorta** var. nov.

Filaments very much contorted, 500–800 μ long; trichomes torulose at the base and 6–7.5 μ diam., cylindrical above and 2.5–3 μ diam.

Growing on the wall of a house in Maricao, *no. 1049,* type.

CALOTHRIX BRAUNII **mollis** var. nov.

Filaments growing in small tufts 80–110 µ long, decidedly bulbous at the base, 8–10.8 µ diam. at the base; trichome tapering gradually from the base, terminating in a slender hair as long as or longer than the main body, bright aeruginous, 5–6 µ diam. at the base; hair 1.4 µ diam.; sheath hyaline, ocreate.

Growing on earth among other Myxophyceae, Maricao, *no. 1037 b,* type.

Calothrix linearis sp. nov.

PLATE 13, FIGURE 21

Filaments attached at the base, erect and straight for the most part, 350–500 µ (up to 1000 µ) long, cylindrical except a short distance at the base and at the apex; trichomes linear, cylindrical throughout except a few cells at the base and at the apex, the former being slightly larger and the latter tapering into a short hair, 5–7 µ diam.; cells quadrate, one-half as long as the diameter, in part constricted at the dissepiments; heterocysts basal, single, or at times more than one, mostly hemispherical; branching usually near the upper end; hormogonia fairly abundant; sheath subgelatinous, hyaline, homogeneous, 2–2.5 µ thick.

Growing on a water pump in Maricao, *no. 1276 a,* type; on a wall near a bridge in Caguas, *no. 461 c.*

Calothrix linearis is a very distinct species. Dr. Wille had suggested in his notes that the material should be made the type of a new genus, based on the non-attenuated character of the trichome. The genus would thus occupy a position between *Calothrix* and *Microchaete,* branching as in the former genus and non-attenuated as in the latter genus. Many of the trichomes are actually slightly larger at the apex than they are further back, as large even as the few largest cells at the base, and in a few instances trichomes with a heterocyst on both ends were observed. Careful search revealed the fact that some of the young trichomes have short tapering apices with terminal hairs. On this account it seems best not to establish a new genus for its reception as probably all of the trichomes in their earliest stages of development produce short ephemeral hairs. After these drop off, meristematic regions are established in many instances and the filament becomes "double-ended," growing in both directions. It seems that no heterocysts are formed intercalary in the main trichome. Branching occurs by the death of one or more cells after which one or both ends may push through the sheath at that point, or only the lower end may form a branch, and the upper hormogonium forms a heterocyst at its base.

Calothrix evanescens sp. nov.

PLATE 13, FIGURE 22

Filaments erect or prostrate, straight or curved, rigid, 200–300 μ long, 7–8 μ diam.; trichomes cylindrical from the basal heterocyst throughout the larger portion of the length, then tapering to a very narrow, short hair, constricted at the dissepiments, 5.5–6.8 μ diam.; cells cylindrical to dolioform, quadrate to one-third the diameter long, mostly homogeneous, pale aeruginous to yellowish or honey-color, mostly showing a clear central area; cross-walls relatively thick and conspicuous; apical cell blunt and rounded, becoming conical in the young stage of growth; the apical portion soon prolonged into a short hair; heterocysts single, basal, spherical to subspherical, same diameter as the trichome; sheath thin, firm, smooth, homogeneous, hyaline, vanishing at about half way from the base to the apex.

Growing in water among other Myxophyceae and debris, Jayuya, *no. 1776 a,* type; on a wall, Coamo Springs, *no. 411.*

In certain stages in the life cycle of this species it resembles the genus *Microchaete.* The hair dies back, the apical portion becomes dolioform, the terminal cell enlarges and becomes rounded, and a sheath is secreted. The whole trichome is then cylindrical with but a single basal heterocyst. When growth begins at the apex, the diameter begins to diminish, the apical cell becomes conical, and finally a short hyaline hair is produced. It is a very distinct species, related in some of its characters to *C. linearis.*

CALOTHRIX JULIANA **tenuior** var. nov.

Filaments 700–900 μ long, 12–14 μ diam. at the base, tapering gradually to a hair at the apex; trichomes 9.5–11.5 μ diam. at the base; cells very short, 1.2–1.8 μ long.

Growing on the roots of water plants in Arroyo de los Corchos, *no. 1696,* type; on twigs in a stream, north of Maricao, *no. 1291.*

Calothrix simulans sp. nov.

PLATE 13, FIGURE 23

Filaments 7–9 μ diam., cylindrical except for a short distance in the apical portion, prostrate at the base, curving away from the host and becoming free, 200–250 μ (up to 400 μ) long; trichomes 6–7 μ diam., cylindrical, except at the outer end where it suddenly tapers into a short hair about 2 μ diam., constricted slightly at the dissepiments; cells quadrate to one-third as long as the diameter, aeruginous, densely congested with small irregular granules; heterocysts basal, single, spherical to subspherical, 6.8–7.2 μ diam.; sheath very thin, firm, hyaline, close-fitting and uniform throughout; spores 1–3-seriate at the base just above the heterocyst, cylindrical, 8–9.5 μ diam., 12–16 μ long.

Growing in water west of the Experiment Station, Rio Piedras, *no. 1946,* type.

This species of *Calothrix* described above is similar in the cylindrical character to *C. evanescens* and to *C. linearis* of this paper, and especially in the possession of spores, the only species in the Porto Rican collection having this character. The plants are epiphytic upon a large species of *Oedogonium.* After the hairs disintegrate, the specimens resemble very closely members of the genus *Microchaete.*

Dichothrix Willei sp. nov.

PLATE 14, FIGURE 24

Filaments about 1 mm. high, forming a dense flocculent stratum, profusely branched, 12–15 μ diam.; trichome narrow, 7–9 μ at the base, very gradually attenuated, ending abruptly, about 2.5–3 μ diam. at maturity, extending into a hair when young, constricted very slightly only at the base; cells quadrate, pale greenish or bluish green, densely congested with small granules; cross-walls very thin, in part very inconspicuous; sheath thick, subgelatinous, as thick as or thicker than the trichome, hyaline when young, homogeneous, changing later to yellowish or honey-color and very finely lamellose; heterocysts hemispherical to spherical at maturity, same diameter as the trichome; branched, 2–5 remaining within a common sheath for only a short distance, the sheath merely enlarging, not ocreate.

Growing in a ditch on rocks by the road about ten kilometers north of Utuado, *no. 1554,* type, and *nos. 1555, 1541, 1566, 1527 b,* and *1539 d.*

MICROCHAETE TENERA **tenuior** var. nov.

Filaments scattered among other algae, 4.8–6.5 μ diam., largest at the apices; trichomes 3.5–4.5 μ diam.; cells densely and coarsely granular; resting spores 5–6 μ diam., 7–11 μ long, in the central and upper parts of the trichome in broken series of 2 to 16; spore wall smooth, brown.

Growing among Hepaticae in company with other algae by the road near Adjuntas, *no. 1571,* type. Collected by Elizabeth G. Britton.

The variety *tenuior* differs from the species in being smaller in all of its measurements and in having the resting spores occurring either singly or in broken series, variable in number, and in size. Very little has been said of the spores in *M. tenera.* Forti (in De Toni, Syll. Alg. **5**: 483) says they are cylindrical and seriate.

Rivularia (GLOEOTRICHIA) **flagelliformis** sp. nov.

PLATE 14, FIGURE 25

Thallus globose to irregular, very soft and gelatinous or mucilaginous in consistency, about 1 cm. diam.; trichomes a considerable distance from each other, constricted at the dissepiments throughout except the terminal hair in the juvenile stage, but on nearing maturity the condition disappearing except with a few cells at the base, up to 1 mm. long, 5.5–6.8 μ diam. at the base before spore formation begins, tapering gradually from the base to the apex, terminating in a long hair 1–1.8 μ diam.; cells granular, aeruginous, mostly quadrate, hair cells 4–6 times as long as broad; heterocysts hyaline, mostly spherical, 11–14 μ diam., others vary from ellipsoidal to conical; sheath undulate, hyaline, visible for about 80 μ, then vanishing into the common transparent gelatinous tegument; spores densely congested with very fine granules, 11–14 μ diam., up to 80 μ long.

Growing in a water reservoir near Rio Piedras, *no. 126,* type.

Scytonema evanescens sp. nov.

PLATE 15, FIGURE 26

Filaments 450–650 μ long, adhering by their gelatinous sheaths into a dense stratum, mostly erect, considerably contorted and more or less parallel, 25–32 μ (up to 40 μ in the apical region) diam.; trichomes clavate, the widest part at the apex of filament, gradually diminishing toward the base where it very frequently vanishes while the apical portion is yet actively growing, 10–14 μ diam. at the apex, more or less deeply constricted at the dissepiments, at times moniliform; cells one-half to one-third the diameter long at the apex of the trichome, increasing in length to 2–3 times as long at the base, homogeneous to finely granular, bright olive-green; heterocysts sparse, subspherical to cylindrical; sheath thick, faintly lamellose and ocreate, hyaline at the apex and uniformly yellowish in the lower parts of the filament, ragged along the margins; branching sparse, mostly single under the heterocysts and in the upper parts of the filament.

Growing on limestone between Arecibo and Utuado, *no. 1482,* type, and *1481*; on limestone between Hatillo and Arecibo, *no. 1397 g*; at Hato Arriba, Arecibo, *no. 1430.*

Scytonema evanescens seems from its structure to be a close relative of *S. crassum* Naegl. Comparison with the material distributed in Rabenhorst's Exsiccatae, *no. 1843,* the nearest to authentic material I was able to examine, shows some important differences. The sheath in *S. evanescens* is much more uneven and ragged and lacks the clearly defined lamellose and ocreate sheath characteristic of *S. crassum.* The color of the sheath in *S. evanescens* is uniformly distributed, while that of *S. crassum* appears first in the parts nearest the trichome, and is less intense in successive layers toward the surface, where it is hyaline. The branching is mostly single and under the heterocyst, but occasionally it is geminate in *S. evanescens.*

Scytonema capitatum sp. nov.

PLATE 15, FIGURE 27

Filaments 22–26 μ (up to 30 μ) diam., more or less erect and parallel, associated into small, closely crowded fascicles forming a velvety stratum 2–3 mm. thick, relatively straight and rigid; trichomes 18–22 μ diam., usually constricted at the dissepiments, especially in the apical portions; cells purplish gray to slightly olive-green, finely granular, one-half to one-fourth as long as broad, quadrate in the oldest parts; heterocysts compressed-spherical to quadrate; sheath thin, membranaceous, yellow, homogeneous, smooth, decidedly capitate at the apices of the filaments, then thickening up to 10 μ; branching sparse, single or geminate.

Growing on rocks about ten miles north of Utuado, *no. 1537 a,* type.

Scytonema capitatum has one character not previously reported in any other species of the genus: *viz.,* the thickening of the apex of the filament. This is apparently not uniform in all of the filaments, but occurs under certain conditions in the same way that the capitate *Homocysteae* occur, typical capitate apices often being difficult to find in a collection of a species which under certain conditions may have them in abundance. The trichomes at times seem to grow very rapidly, extending far beyond the sheath. A sheath is then secreted, and it appears as though the apical cell secretes much more than the cells farther back in the trichome. The cap is frequently as much as eight or ten microns thick, whereas the sheaths are from two to four microns thick. When in rapid division the cells in the meristematic region are often not over two and a half microns thick, and in the older parts of the trichome quadrate cells may be found.

Scytonema longiarticulatum sp. nov.

PLATE 15, FIGURE 28

Filaments associated with other algae, not forming a definite stratum alone, 400–500 μ long, 15–18 μ diam., arcuate or almost straight; trichomes not constricted at the dissepiments, 9–11 μ diam. at the apices, 5–8 μ diam. in the body of the filament; cells olive-green, finely granular, 18–25 μ (up to 35 μ) long in the body of the filament; heterocysts cylindrical, of the same size as the cells, sparse; sheath at first completely hyaline, finally becoming brown in contact with the trichome, the thick surface layer remaining hyaline for considerable length of time but finally the whole sheath becoming dark brown, homogeneous or faintly lamellose at maturity, the lamellae not diverging.

Growing in association with other species of Myxophyceae on pulverized rock at "Campo," Maricao, *no. 1229 a,* type; on rock at Jayuya, *no. 1768.*

The species of *Scytonema* diagnosed above has the longest cells of all of the known species and is closely related to *S. pulchellum.*

Scytonema subgelatinosum sp. nov.

PLATE 15, FIGURE 29

Filaments erect for the most part, more or less fasciculate, sparsely branched, about 1 mm. long, 10–13 µ diam.; trichomes clavate at the outer apical end, 3–5 µ diam. in the older parts, 6–9 µ diam. at the apices; cells up to 24 µ long, cylindrical or slightly dolioform in the middle and older parts, decidedly dolioform at the apices in some of the younger filaments, pale aeruginous, homogeneous; cross-walls very inconspicuous; heterocysts of the same size and shape as the cells; sheath relatively thick, subgelatinous, homogeneous, hyaline; branching mostly single but some geminate.

Growing on rocks by a water reservoir in Rio Piedras, *no. 108,* type; on rocks at the Experiment Station, Rio Piedras, *no. 174;* on rocks by the road to Monte Montoro, Mariacao, *no. 1066*; north of Maricao, *no. 1246.*

Scytonema variabile sp. nov.

PLATE 15, FIGURE 30

Filaments mostly straight or arcuate, more or less coalesced into erect fascicles about 2 mm. high, sparsely branched, both single and geminate types of branching being represented; main filaments 34–42 µ diam., branches smaller, all filaments very variable in diameter in different parts; trichomes very variable in diameter in different parts of the same filament, usually a little larger at the apices than in the main body of the filament, up to 25 µ diam.; cells cylindrical, slightly constricted at the dissepiments to decidedly dolioform, mostly quadrate or less, in part 2 times as long as the diameter, bright aeruginous, in part homogeneous, and in part congested with granules; heterocysts as variable in shape and size as the cells; sheath hyaline to yellowish brown; 6–12 µ thick, homogeneous or with a few divergent laminae, subocreate, subgelatinous.

Growing among moss on a waterpipe by a stream near Maricao, *no. 1149 a,* type, and *no. 1153.*

This interesting species of *Scytonema* belongs equally well in either section II, Myochrotes Born. & Flah., or section III, Petalonema Berk., as aranged by Forti.[14] The sheath becomes relatively thick and remains homogeneous in some parts of some of the filaments. In others there are a few laminae and they turn outward, as in the group Myochrotes. In cases in which several successive periods of growth have followed each other in rapid succession at the apices, the ocreate condition characteristic of Petalonema appears. Rather unusual variability exists in all of the characters of the species. The same filament may be almost twice as thick in some parts as in others. The cells may be very short, one-fourth the diameter long in the main body of the trichome. They may be perfectly cylindrical or dolioform in the older parts of the trichome.

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[14] In De Toni, Sylloge Algarum **5**: 516, 526. 1907.

Scytonema magnum sp. nov.

Plate 16, figure 31

Filaments 400–600 μ long, 24–32 μ diam., densely interwoven, forming a flocculent stratum 1–1.5 mm. thick; trichomes 15–22 μ diam.; cells cylindrical to dolioform, subquadrate in the meristematic region, up to twice as long as the diameter in the older parts, purplish gray, mostly homogeneous; cross-walls thin but distinct; heterocysts numerous, of the same size and shape as the cells, yellowish brown; sheath thick at first, hyaline and homogeneous, becoming yellowish brown and lamellose, the lamellae not divergent, surface smooth.

Growing on rocks in a brook about five kilometers north of Utuado, *no. 1609*, type; on rocks between Utuado and Adjuntas, *no. 1661*.

The material in the above-mentioned collections is well advanced in age, and the branching is very sparse, but as far as observed, the branches are geminate.

Scytonema punctatum sp. nov.

Plate 16, figure 32

Filaments loosely entangled into a floccose stratum 2–4 mm. thick, moderately tortuous, sparsely branched, 18–26 μ diam.; trichome bright aeruginous, not constricted at the dissepiments, 14–18 μ diam. throughout; cells cylindrical, one-half to one-third as long as the diameter at the apices, quadrate to twice as long in the older parts of the trichome, very finely and more or less densely granular; walls thin and white; heterocysts of the same shape and size as the cells, slightly yellowish; sheath hyaline or in extreme age yellowish, homogeneous, filled with very small refringent granules, 2–3.8 μ thick.

Growing on rocks between Utuado and Adjuntas, *no. 1658,* type.

The species above described may be distinguished from other known species by the relatively large diameter of the trichomes, not diminishing appreciably in the older parts, the bright aeruginous cylindrical cells which are usually very finely granular, and the hyaline, finely punctate sheath, especially so in the older filaments.

SCYTONEMA MILLERI **majus** var. nov.

Filaments forming small tufts or a continuous stratum about 4 mm. thick, densely packed together, erect, very flexuous, 20–25 μ diam.; cells slightly dolioform at the apices of the trichomes, cylindrical in the older parts, one-half to one-third the diameter long at the apices, mostly quadrate in the older parts; branching and heterocysts sparse; sheath thick, firm, dark brown, homogeneous.

Growing on rocks by a stream near Maricao, *no. 1166,* type.

The measurements given by Forti[15] for the filaments of *S. Milleri* are 15–21 μ in diameter. The material distributed in the copy of Wittrock, Nordstedt and Lagerheim, Alg. Exsic., *no. 1511,* at the Farlow Herbarium, Harvard University, determined by Flahault, measures 12–15 μ in diameter. The material described above resembles *no. 1511* (*loc. cit.*) very much, but is larger in all of its parts. It is close to some forms of *S. guyanense,* but has a firm, homogeneous sheath, and the material is thoroughly mature.

Scytonema pulchellum sp. nov.

PLATE 16, FIGURE 33

Filaments 10–15 μ diam., moderately straight, long, arcuate, rigid, entangled into a flocculent stratum about 2 mm. thick, sparsely branched, either single under the heterocysts or geminate between the heterocysts; trichomes very distinct, variable in diam., largest in the meristematic regions, diminishing in the older parts; 5–10 μ diam., not constricted at the dissepiments; cells cylindrical, 2–3.5 times as long as the diameter in older parts of the trichome, quadrate to one-half as long at the apices; pale olive-green, homogeneous or with one to several refringent granules; cross-walls distinct, thin; heterocysts of the same shape and size as the cells; sheath at first homogeneous and hyaline, becoming lamellose and various shades of brown when older, smooth, firm.

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[15] In De Toni, Sylloge Algarum **5**: 505. 1907.

Growing on rocks by a stream, Utuado, *no. 1574,* type; on rocks, near Utuado, *no. 1494,* collected by Elizabeth G. Britton; on earth, Utuado, *no. 1501 a*; among moss, etc., three kilometers north of Utuado, *no. 1605.*

Scytonema pulchellum is apparently closely related to *S. ocellatum* Lyngb. but may be distinguished from it by the thick, smooth, lamellose sheath, resembling that of *S. guyanense* (Mont.) Born. & Flah., and by the long cylindrical cells in the older parts often containing refringent granules.

The branches are about equally single or geminate, the single branches arising under the heterocysts.

Scytonema catenulum sp. nov.

PLATE 17, FIGURE 34

Filaments densely aggregated into erect fascicles 1.5–2 mm. long, more or less agglutinated by their gelatinous walls; 18–26 μ diam., sparsely branched; trichomes moniliform when old, 8–12 μ diam., the greater diameter being at the apices, diminishing gradually in the older parts, in some cases entirely vanishing, at the same time the sheath increasing in thickness correspondingly; cells compressed dolioform at the apices, becoming subspherical in the older parts, yellowish green to bright aeruginous, homogeneous; cross-wall inconspicuous; heterocysts compressed spherical to concave when old; sheath subgelatinous, homogeneous, and hyaline when young, becoming indistinctly lamellose and ocreate at the apices, and yellowish when mature, roughened on the surface; branching mostly single toward the apices, geminate in part below.

Growing on rocks about ten kilometers north of Utuado, *no. 1556,* type, and on earth, *no. 1561.*

This species of *Scytonema* is well marked by the character of the cells combined with the indistinctly ocreate sheath. The cells in the meristematic region are very short and dolioform. As the growing region moves forward, the successive cells become more and more spherical, the sheath thickening and pushing in between the cells and eventually, in many instances, completely separating them. As the successive cells diminish in diameter, the sheath becomes correspondingly thicker, and finally many cells completely disappear.

SCYTONEMA MIRABILE **majus** var. nov.

Filaments 1–2 mm. high, 22–28 μ diam.; trichomes 9–14 μ diam.; cells purplish gray, finely granular in part.

Growing on damp rocks about five kilometers north of Utuado, *no. 1617,* type; about ten kilometers north of Utuado, *no. 1563.*

Scytonema lyngbyoides sp. nov.

PLATE 17, FIGURE 35

Filaments forming a dense velvety stratum, or more or less intertwined and pannose, 28–32 μ diam. in main filaments, branches as small as 20 μ diam.; trichomes 18–25 μ diam., more or less constricted at the dissepiments; cells one-third to one-sixth as long as the diameter, bright violet to olive-green, homogeneous; cross-walls thin, but distinct; heterocysts of the same shape and size as the cells, hyaline, sparse; sheath hyaline, homogeneous; branching geminate for the most part, occasionally single.

Growing on rocks in a brook about five kilometers north of Utuado, *no. 1607,* type; on rocks between Utuado and Adjuntas, *no. 1646.*

The violet or dark olive-green color of the trichomes, the homogeneous hyaline sheath, the sparsity of the hyaline heterocysts, and the lack of abundant branching, characteristic of the above newly described species, remind one at first sight of the genus *Lyngbya*; hence the specific name.

Scytonema tenue sp. nov.

PLATE 17, FIGURE 36

Filaments mostly straight, erect, parallel, closely associated, forming a velvety stratum, sparsely branched, the branches arising near the base, 0.75–1 mm. high, 6–8 μ diam.; trichomes 5.5–6.5 μ diam. at the apices, 2–2.5 times as long in older parts; cells cylindrical in the body of the filament, and not constricted, slightly dolioform at the apices, pale aeruginous, homogeneous; sheath subgelatinous, hyaline, homogeneous, 2–2.5 μ thick; heterocysts cylindrical, quadrate to 2 times as long.

Growing on rocks at a water reservoir, Rio Piedras, *no. 106,* type.

The closest affinities of this species of *Scytonema* apparently are *S. tenuissimum* Schmidle, a smaller species with thinner sheath, and *S. intermedium* De Wild., a larger species.

SCYTONEMA GUYANENSE **minus** var. nov.

Filaments 12–18 μ diam., long, flexuous, forming a thin, floccose stratum; trichomes up to 13 μ diam. at the apices, 6–8 μ in older parts; cells cylindrical, or slightly torulose at the apices, quadrate or less at the apices of the trichomes, 2–4 times as long as the diameter in the older parts, homogeneous or with a few refringent granules; sheath slightly lamellose, lamellae not diverging.

Growing on lava between Arecibo and Utuado, *no. 1455,* type.

Variety *minus,* as diagnosed above, differs from the species chiefly in having on the average smaller filaments, thinner and less lamellose sheaths, and longer and narrower cells in the main body of the filament.

SCYTONEMA OCELLATUM **purpureum** var. nov.

Filaments forming a pulvinate or floccose stratum 1–2 mm. thick, 1–1.5 mm. long, 14–18 μ diam.; cells homogeneous, purplish or pale violet, subquadrate to 2 times as long as the diameter; otherwise as species.

Growing on soil, Coamo Springs, *no. 292 c,* type; on soil in a waterfall, about twelve kilometers north of Ponce, *no. 1686.*

SCYTONEMA OCELLATUM **majus** var. nov.

Filaments 18–22 μ diam., about 1 mm. long; cells cylindrical, purplish gray; sheath thin, firm, homogeneous, smooth, brown; branching both single and geminate.

Growing on limestone at Hacienda, Laguna Tortuguero, *no. 867,* type; on rocks by a stream near Maricao, *no. 1157.*

SCYTONEMA OCELLATUM **constrictum** var. nov.

Filaments much contorted, 15–19 μ diam.; trichomes 12–14 μ diam., heterocysts subspherical to much compressed, frequently of less diameter than the trichomes, the filament being constricted at the heterocysts under such circumstances.

Growing with other species of *Scytonema* on rocks by the road north of Maricao, *no. 1253,* type.

Scytonema spirulinoides sp. nov.

PLATE 17, FIGURE 37

Filaments 500–800 μ long, 15–20 μ diam., more or less frequently curved and spirally coiled, forming a flocculent stratum; trichomes 10–12 μ diam. at the apices, not constricted, much reduced in diameter in the older parts; cells cylindrical, one-half to one-third as long as the diameter at the apices, quadrate in the older parts, densely and finely granular; cross-walls indistinct; heterocysts of the same shape and size as the cells, very sparse; branching very sparse; sheath thick, homogeneous, dark brown, rough on the margin.

Growing on rocks along the road near San Lorenzo, *no. 534,* type.

This species is to be distinguished from others by the very much distorted character of the filaments. Its nearest relative possibly might be considered to be *S. ocellatum.*

Scytonema tenellum sp. nov.

PLATE 18, FIGURE 38

Filaments 200–300 μ long, 12–16 μ diam., flexuous and densely intertwined, more or less erect, forming a thin, very dark stratum, profusely branched; trichomes cylindrical, not tapering, very slightly constricted at the dissepiments, 10–14 μ diam.; cells one-half to one-fourth as long as the diameter, homogeneous, pale aeruginous, cross-walls very thin but plainly visible; heterocysts numerous, golden yellow, of the same shape and size as the cells, or in part almost quadrate; sheath thin, smooth, homogeneous, dark brown, close fitting; branching geminate, perpendicular at first, soon gently curving.

Growing on lava rock north of Sabana Grande, *no. 936 a,* type.

Scytonema javanicum (Kuetz.) Born. & Flah. has several characters linking it with *S. tenellum.* The latter is to be distinguished, however, by its very much shorter filaments, its much more profuse branching, and its shorter cells. The branches are much curved in various directions and frequently two to three orders remain intact instead of separating as is usually the case.

SCYTONEMA JAVANICUM **pallidum** var. nov.

Filaments flexuous, 9.5–12.5 μ diam., densely intertwined, forming a flocculent stratum; trichomes not constricted, 7–9 μ diam.; cells cylindrical throughout the trichome, quadrate to slightly greater or less than the diameter, pale grayish or aeruginous; sheath thin, membranaceous, hyaline at the apices, brown below.

Growing on serpentine rock near Mayagüez, *no. 899 a,* type.

SCYTONEMA JAVANICUM **distortum** var. nov.

Filaments 13.8–15 μ diam., 200–300 μ long, branching frequent, mostly by bowing out of the trichome and later breaking apart, much contorted; heterocysts numerous, much compressed.

Growing on trees north of Mayagüez, *no. 1000,* type.

The variety is to be distinguished from the species by the method of branching, the trichomes pushing out in the form of a loop, and breaking in two later. The frequent branching of the short filaments causes them to become much distorted.

Scytonema multiramosum sp. nov.

PLATE 18, FIGURE 39

Filaments erect, entwined into dense fascicles more or less agglutinated by the soft, slightly gelatinous sheaths, 1.5–2.5 μ long, 9.5–13 μ diam., profusely branched in pairs in the upper parts of the filament between the heterocysts; trichomes 7–8 μ diam. at the apices, gradually diminishing to 3 μ diam. in older parts; apical cells slightly dolioform, subquadrate, densely granular, other cells 1.5–4 times as long as the diameter; heterocysts quadrate to twice as long as the diameter; sheath thin at the apices, gradually thickening as the trichomes diminish in size, hyaline, and homogeneous when young, becoming yellowish and laminated when old, the lamellae divergent, and slightly ocreate at the apices.

Growing on moist rocks about ten kilometers north of Utuado, *no. 1527,* type.

The young stages of this species of *Scytonema* very closely resemble *S. subgelatinosum* of this paper. The sheath when young is hyaline and homogeneous, and the filaments relatively short, permanent characters of *S. subgelatinosum.* At maturity the branching is very profuse near the outer ends of the filaments, the sheath becomes brownish, laminated, and in part ocreate, characters which do not appear in *S. subgelatinosum.*

Hassalia brevis sp. nov.

PLATE 18, FIGURE 40

Filaments 100–130 μ long, 8.5–10.5 μ diam., densely matted together forming a thin, pannose stratum; mostly straight or arcuate in part; trichome frequently separated at the heterocyst, forming numerous short filaments; cells 7.2–8.4 μ diam., dolioform, about one-half the diameter long; heterocysts numerous, compressed-spherical, golden-colored; sheath very thin, smooth and hyaline; branches short, 50–70 μ long.

Growing on a concrete fountain in Fajardo, *no. 659,* type; on trees, Coamo Springs, *no. 300 c*; on old wood at Hacienda Catalina, Palmer, *no. 747*; Laguna Tortuguero, *no. 864;* on loose rock about seven kilometers east of Coamo, *nos. 1869 b* and *1870 f.*

Practically all of the material at hand of this species of *Hassalia* is in the hormogonial stage, the filaments having separated at the heterocysts by the decay of the delicate sheath at that point. There are a few branches intact, however, that show clearly the rupture of the sheath and the filament emerging just below the heterocyst. The sheath decomposes at a very large percentage of the heterocysts, whether branches arise there or not, leaving the whole mass of filaments broken, and the heterocysts all basal on the trichomes.

Hassalia granulata sp. nov.

PLATE 18, FIGURE 41

Filaments 100–200 μ long, 11–13.5 μ diam., straight or somewhat arcuate, forming a very thin, more or less flocculent stratum; trichomes 10–12 μ diam., pale aeruginous, very slightly constricted at the dissepiments, of uniform diameter throughout the entire length; cells one-third to one-fourth the diameter long, densely congested with granules, often collected along the very inconspicuous cross-walls; heterocysts subglobose to much compressed, golden yellow, mostly terminal, brought about by rupture of the sheath at that point in the filament; sheath very thin, smooth, homogeneous, golden yellow; branching sparse.

Growing on bark along the road near Coamo Springs, *no. 1913,* type.

The medium size of the filaments, the thin, close-fitting colored sheath, and the pale-colored cells densely congested with granules distinguish this species of *Hassalia* from others. In size it is between *Scytonema Hofmanni* and *S. javanicum*, but the branching is all single under the heterocysts, a typical *Hassalia.*

Hassalia heterogenea sp. nov.

PLATE 19, FIGURE 42

Filaments very short, much contorted, with smooth, gentle curves, moderately branched, about equally single and geminate branching, soon recurving, 13–16 µ diam.; trichomes 9.5–13 µ diam., not constricted at the dissepiments, or only moderately so in part; cells quadrate in the older parts, one-half to one-fourth as long as the diameter at the apices, pale aeruginous, homogeneous; heterocysts of the same shape and size as the contiguous cells; not abundant; sheath close-fitting, thin, homogeneous, dark brown.

Growing on rocks at Hacienda Holm, Mayagüez, *no. 1191,* type; on lava rock at Coamo Springs, *nos. 1923 a* and *1921.*

The above-described species might be almost equally well placed in either *Scytonema* or *Hassalia.* On account of its diminutive size and short branches I have placed it in the latter genus.

Hassalia discoidea sp. nov.

PLATE 19, FIGURE 43

Filaments scattered among other algae, not forming a definite stratum alone, relatively short, comparatively straight, 22–25 µ diam. in main filaments, less in the branches; branching moderately frequent, simple under the heterocysts and appressed; trichomes much constricted at the dissepiments, 17–20 µ diam., uniform throughout the entire length; cells discoid, 4–6 µ long, or slightly longer in the oldest parts, bright blue-green or methyl green, finely granular; heterocysts of the same shape and size as the cells, golden yellow, numerous; sheath 2–3 µ thick, smooth, homogeneous, hyaline, changing to yellowish.

Growing on rocks in association with Hepaticae and with other species of Myxophyceae, about seven kilometers east of Coamo, *no. 1870,* type.

This species is closely related to *H. scytonematoides* of this paper. The cells are more discoid and of a brighter green color, and the sheath is thin, firm, not lamellose nor ocreate.

Hassalia scytonematoides sp. nov.

Plate 19, figure 44

Filaments arcuate, densely intertwined among other algae, together forming a flocculent stratum, branching freely and singly under the heterocysts, rarely geminate, 18–24 μ diam.; trichome 15–19 μ diam., pale aeruginous to purplish drab, constricted at the dissepiments; cells one-fourth to one-half as long as the diameter, homogeneous; heterocysts of the same shape and size as the cells; sheath lamellose and ocreate in part, pale yellowish to dark brown.

Growing on bark along the road to Monte Montoro, Maricao, *no. 1087 a,* type.

Hassalia scytonematoides is very intimately associated with different species of *Scytonema* and *Stigonema.* No pure material was found in the whole Wille collection. It is a very distinct species but is liable to be overlooked on account of its close resemblance to uniseriate Stigonemas and nearly related Scytonemas. It may readily be distinguished when branching.

Hassalia rugulosa sp. nov.

Plate 19, figure 45

Filaments 150–250 μ long, very much contorted, forming a dense, flocculent stratum one-fourth to one-third mm. thick, black on being dried, 14.5–17.5 μ diam.; branching single under the heterocysts, rarely geminate; trichomes 6–9 μ diam.; broadest at the apices, narrowest at the bases; cells pale blue-green, one-half to one-third as long as the diameter at the apices, and torulose, quadrate or longer in the older parts and almost cylindrical; heterocysts usually a little wider than the adjacent cells; subspherical to very much compressed, 2–5 μ long; sheath 3.5–5 μ thick, homogeneous, dark brown, roughened on the surface with fine irregular granules.

Growing on rocks by the road near San Lorenzo, *no. 517,* type.

The very much contorted habit and the secretion of granules on the sheath, coupled with the combination of other characters mentioned above distinguish this species of *Hassalia.*

Hassalia fragilis sp. nov.

PLATE 20, FIGURE 46

Filaments 5.5–7 μ diam., very short, straight and rigid, forming a thin velvety stratum; trichomes 4–5.5 μ diam.; cylindrical throughout the entire length, not constricted at the dissepiments; cells quadrate in the older parts about one-half as long as broad at the apices of the trichomes; aeruginous, more or less finely granular; heterocysts spherical to somewhat compressed, numerous, appearing very generally at the base of the filaments caused by the separation at the point of the more or less continuous and profuse branching; sheath thin, homogeneous, hyaline, close-fitting, readily dissolved at the point of false branching of the trichome.

Growing on old wood at Hacienda Catalina, Palmer, *no. 747 c,* type; on trees in a ravine near Coamo Springs, *no. 1896 b.*

This is a species of *Hassalia* with affinities close to *H. Bouteillei* (Bréb. & Desm.) Born. & Flah., but differing in several minor details.

Tolypothrix papyracea sp. nov.

PLATE 20, FIGURE 47

Filaments woven into a very firm, dense, thin stratum, relatively short, 6–7 μ diam.; trichomes 3.6–4 μ diam., of uniform diameter throughout their entire length except 1–3 cells at the apices, slightly attenuated, constricted at the dissepiments; cells quadrate when in rapid division, 3–4 times as long as the diameter in the mature parts of the trichome, bright aeruginous, homogeneous, or with a few fine granules; cross-walls conspicuous; heterocysts sparse, cylindrical, diameter slightly greater than the trichome; sheath thin, firm, smooth, hyaline; branches erect.

Habitat and exact locality not given. Collected by Dr. Walter C. Earle in the vicinity of Manati, Porto Rico.

TOLYPOTHRIX PENICILLATA **brevis** var. nov.

Filaments 1–2 mm. long, intermixed with other filamentous algae, main filaments 18 μ diam., branches smaller; trichomes

12–14 μ diam.; cells cylindrical to slightly dolioform, quadrate to 3 times as long; sheath thin, hyaline; heterocysts up to 50 μ long, cylindrical.

Growing among other filamentous algae and water plants, not forming a definite stratum alone, in a water reservoir at Rio Piedras, *no. 118,* type, and *nos. 111, 115,* and *119 a*; along the shore of Laguna Tortuguero, *no. 843.*

The variety *brevis* differs from the species in having shorter filaments with the diameter averaging greater and with the cells and heterocysts longer. *No. 115* has mature cells averaging 38 to 45 μ long in the older parts of the trichome.

Tolypothrix amoena sp. nov.

PLATE 20, FIGURE 48

Filaments 10–15 μ long, 22–26 μ diam., densely interwoven into a pannose stratum, very smooth and of equal diameter throughout the entire length; trichomes cylindrical, constricted in part at the dissepiments, 16–18 μ diam., of the same diameter throughout the entire length; cells in part short cylindrical and in part dolioform, one-third to one-fifth the diameter long, homogeneous or very finely granular, bright aeruginous, changing to yellowish or greenish gray on drying; sheath very smooth and straight, homogeneous, hyaline to slightly brownish; heterocysts ranging from almost cylindrical and longer than the diameter through quadrate, spherical, to very much compressed, becoming disk-shaped, prevailingly spherical, single or 2–5-seriate, very numerous throughout the trichome; branching sparse.

Growing in a pool west of the Experiment Station, Rio Piedras, *no. 1932,* type, and *nos. 1935, 1936, 1941, 1943, 1945,* and *1952*; in a stream about five kilometers east of Coamo, *no. 221 c.*

Tolypothrix amoena is a very distinct species, being very definite in all of its characters. It has long, relatively straight and rigid filaments. The sheath is firm, smooth, and homogeneous. In some parts of the trichome the heterocysts are almost cylindrical, in others they are spherical and in still others very much compressed, but always very distinct and conspicuous. The cells are either perfect, short cylinders with no constrictions, or dolioform and conspicuously constricted.

Tolypothrix robusta sp. nov.

PLATE 20, FIGURE 49

Filaments more or less matted together, forming a pannose stratum, 1–2 mm. long, 22–30 μ diam., straight or arcuate, fairly rigid; trichomes 12–18 μ diam., the smaller diameter in the older parts of the filament, the larger at the apex, constricted more or less at the dissepiments; cells very short, 2–4 μ long in the meristematic region, quadrate in the older parts, bright aeruginous, densely and finely granular; heterocysts of the same size and shape as the cells; sheath hyaline, homogeneous, and subgelatinous when young, changing to lamellose and becoming successively colored brown from the trichome outward.

Growing in association with other algae in Laguna Tortuguero, *no. 827,* type, and *no. 826.*

Tolypothrix Willei sp. nov.

PLATE 20, FIGURE 50

Filaments growing in microscopic tufts among other algae, up to 1 mm. long, 7–8.5 μ diam., sparsely branched; trichomes 2.4–2.6 μ diam. in the older parts, 4.2–4.6 μ diam. at the apices; cells quadrate to 3.5 times (up to 6 times) as long as the diameter, cylindrical when mature, slightly dolioform in the meristematic region at the apex of the trichome, mostly homogeneous; apical cell frequently subspherical; heterocysts sparse, of the same shape and size as the cells; sheath relatively thick, hyaline, homogeneous.

Growing in a reservoir west of the Experiment Station, Rio Piedras, *no. 209 a,* type; in a pool in Jayuya, *no. 1649 a.*

Tolypothrix Willei apparently is a close relative of *T. fasciculata* Gomont. It does not form the fascicles characteristic of that species, is shorter and narrower, and has much longer cells in the older parts of the trichomes.

STIGONEMA HORMOIDES **constrictum** var. nov.

Filaments short, crooked, slightly branched, 11–13 μ diam., constricted at the dissepiments; cells quadrate to one-half as long as the diameter, slightly constricted when young, becoming much more so with age, pale grayish green; hormogoniferous branches very short; sheath very thin, hyaline or slightly colored when old.

Growing on damp fern roots and on soil about twenty kilometers north of Ponce, *no. 1810,* type.

This form of *Stigonema* may readily be distinguished from the other forms of *S. hormoides* by the thin wall, which is deeply constricted at the dissepiments of the trichome.

STIGONEMA HORMOIDES **nodulosum** var. nov.

Filaments 8–9 μ diam., short, very crooked and nodular; cells close together, subspherical; tegument thin, firm, homogeneous, dark brown; branches very sparse, short; heterocysts sparse.

Growing on rocks in a waterfall of a warm stream, Coamo Springs, *no. 310,* type.

STIGONEMA HORMOIDES **rigidum** var. nov.

Filaments 250–350 μ long, 8.5–10 μ diam., moderately curved, sparsely branched, firm and rigid; cells in youngest specimens cylindrical, quadrate to one-half the diameter long, later becoming dolioform to subspherical; tegument thin, close-fitting, firm, homogeneous, dark brown.

Growing on red earth near Mayagüez, *no. 880 f,* type.

STIGONEMA HORMOIDES **lineare** var. nov.

Filaments 300–500 μ long, comparatively straight, sparsely branched, with branches as long and of the same dimensions as the main frond, 7–8 μ diam., sheath very thin, smooth, hyaline at first, soon changing to yellowish; cells finely granular.

Growing on soil at the Experiment Station, Rio Piedras, *no. 117a,* type.

In this form of *S. hormoides* the sheath is very thin and the cells stand close together. In the young and rapidly growing stage the filaments resemble those of a species of *Phormidium.*

Stigonema elegans sp. nov.

PLATE 20, FIGURE 51

Filaments 400–500 μ long, 16–20 μ diam., with longer or shorter curves, forming a more or less flocculent stratum; branches not abundant, of two sorts, one short and pointed, hormogoniferous, and the other like the main axis, arising at right angles, not attenuated; cells in part uniseriate and in part pluriseriate, compressed-spherical, with distinct walls between and protoplasmic connections, about one-half as long as broad, homogeneous, bright blue-green; heterocysts formed by longitudinal division of vegetative cells one-half of each becoming a heterocyst; sheath smooth, firm, 2–2.5 µ thick, homogeneous, dark brown; hormogonia secund, 45–60 µ long.

Growing on "Flytteblok," near Humacao, *no. 573,* type, and *no. 575 b;* on rocks at Laguna Tortuguero, no. *852 d;* on soil along the road, Maricao, *no. 1247;* on bark by the road, north of Maricao, *no. 1261;* on old plants on lava in a primeval forest, near Hacienda Catalina, Palmer, *nos. 768 a* and *769.*

STIGONEMA ELEGANS **minus** var. nov.

Filaments sparsely branched, 14–16 µ diam., trichomes 8.8-11 µ diam.; cells uniseriate, quadrate to one-half as long as the diameter.

Growing on rocks by the Arroyo de los Corchos, *no. 1715 a,* type.

The variety differs from the species in having smaller filaments, smaller trichomes, and the cells averaging longer with respect to the diameter.

Stigonema congestum sp. nov.

PLATE 21, FIGURE 52

Filaments 150–225 µ long, 12–15 µ diam., very much contorted and intertwined, forming a thin, dense stratum; branches numerous, of 2 or 3 orders, all of similar diameters, slightly constricted at the base, arising at right angles, but soon bending upward; cells uniseriate or when aged in part pluriseriate, closely crowded, irregular in form, about one-half the diameter long, homogeneous; cross-walls thin; tegument thin, firm, smooth, homogeneous, dark brown; heterocysts fairly abundant.

Growing on stones near Hacienda Catalina, Palmer, *no. 791,* type; on rocks near San Lorenzo, *no. 503*; in a stream about five kilometers east of Coamo, *no. 1886 e*; on "Flytteblok," west of Humacao, *nos. 570 a* and *571 b;* on red earth by the road, Hacienda Catalina, Palmer, *no. 776*; on red earth by the road north of Maricao, *no. 1241;* on trunk of a palm tree at Santurce, *no. 23*; on lava north of Sabana Grande, *no. 923 a* and *936.*

Stigonema cornutum sp. nov.

PLATE 21, FIGURE 53

Filaments very irregular in shape and size, the main part usually very blunt, 25–30 μ (up to 50 μ) diam.; branches of two sorts, one similar to the main frond, sparse, arising without any order, deeply constricted at the base, later completely separated at the constricted base from the parent frond; the other more numerous, arising in a similar manner, smaller, bearing a long, sharp, usually curved, hyaline apex, changing to amber color after the hormogonia disappear, the latter may or may not be deciduous; cells 4–6-seriate, 8–12 μ diam.; heterocysts small, rather sparse; sheath homogeneous, hyaline, changing to slightly yellowish when old.

Growing on soil along the road towards Monte Montoro, Maricao, *no. 1077,* type; on moss, fern roots, etc., between Aibonito and Cayey, *no. 1975.*

The cornute habit of *Stigonema cornutum* reminds one of Kuetzing's *Stigonema polyceras* (1851, *pl. 38*) in which the attenuated portion contained cells. It was learned later that Kuetzing's plant is a lichen. The attenuated portion of the branches in the above species consists of homogeneous, hyaline tegument, and the plant is a typical *Stigonema.* The cells in *no. 1290* are larger than those of the type and more regularly arranged in nodes.

STIGONEMA MINUTUM **parciramosum** var. nov.

Filaments blunt and irregularly bent, not oriented into upper and lower ends, smooth and fairly regular on the surface, very sparsely and irregularly branched, 28–32 μ diam.; hormogoniferous branches 30–45 μ long, other branches similar to the main filament; cells 4–6-seriate, longer than the diameter, finely granular, bright bluish-green; tegument thin, firm, smooth, homogeneous, yellowish brown.

Growing on "Flytteblok," west of Humacao, *no. 568,* type.

STIGONEMA MINUTUM **tuberculatum** var. nov.

Filaments very crooked and tuberculate, branching very irregular, numerous; cells distributed without order; tegument hyaline, changing to yellowish brown, homogeneous.

Growing on "Flytteblok," west of Humacao, *no. 571 a,* type, and *no. 566 a.*

STIGONEMA MINUTUM **ramentaceum** var. nov.

Filaments 300–400 μ (up to 600 μ) long, profusely beset with short, blunt, hormogoniferous ramuli on all sides; main filaments about 25 μ diam.

Growing on old wood at Laguna Tortuguero, *no. 848*, type.

Stigonema ramosissimum sp. nov.

PLATE 21, FIGURE 54

Fronds about 500 μ high, profusely branched, more or less arborescent, all of the parts crooked and about equal in diameter, blunt, 25–30 μ diam.; cells 4–6-seriate, without definite arrangement, the zones being more or less disarranged by secondary, horizontal cell division, spherical to subspherical, or irregular in shape and size, closely crowding the thin, yellowish brown, homogeneous wall, producing a somewhat tuberculate appearance, 7–10 μ diam.; individual cells or groups of cells enclosed in a distinct tegument at maturity; hormogoniferous branches numerous, short, arising on all sides and terminating most of the branches.

Growing on rocks at Laguna Tortuguero, *no. 852 c,* type; on old palm trunks at Hacienda, Laguna Tortuguero, *no. 870;* on red earth at Maricao, *no. 1025 a.*

Stigonema spiniferum sp. nov.

PLATE 22, FIGURE 56

Filaments 500–700 μ long, 35–45 μ (up to 60 μ) diam., very irregularly and profusely branched, no distinction into main fronds and branches; all branches more or less attenuated and terminating in more or less curved, spine-like, hormogonial portions; cells multiseriate in part but usually 4-seriate, in distinct nodular clusters, when numerous subspherical, usually the longitudinal diameter longer than the cross diameter, olive-green, homogeneous; sheath 10–15 μ thick, hyaline, homogeneous, in age the teguments of the individual cells and groups of cells yellowish; the hormogoniferous apical portions, or branches, thick, white, attenuated to a very sharp point, 60–90 μ long; hormogonia usually clavate and uniseriate, larger at the outer end, escaping by rupture of the outer end of the spine; heterocysts sparse and inconspicuous.

Growing on soil at "Campo," Maricao, *no. 1229,* type.

Stigonema spiniferum is closely related to *S. cornutum* of this paper, but differs from that species in having larger cells, fewer series of cells, and particularly in having all of the vegetative branches terminating in long, more or less curved, hyaline spines, bearing the hormogonia, whereas in *S. cornutum* the hormogoniferous branches are specialized.

Stigonema scytonematoides sp. nov.

PLATE 22, FIGURE 57

Filaments relatively short and straight, 125–175 μ long, 23–27 μ thick, sparsely branched; branches similar to the main frond, blunt and rounded; cells uniseriate, compressed-spherical, when old and dried drawn out somewhat at the poles, showing distinct protoplasmic connections, bluish-green, homogeneous, 11–13 μ diam.; heterocysts similar to the cells in shape, size, and form; sheath thick, subgelatinous, faintly lamellose, particularly so toward the apices where the laminae turn outward and backwards from several cells, yellowish brown; hormogonia short and blunt.

Growing on red earth north of Maricao, *no. 1250,* type; on red earth near Mayagüez, *no. 880 e*; on rocks by the road north of Maricao, *nos. 1245, 1250,* and *1253 a*; on rocks between Utuado and Adjuntas, *no. 1643*; on rocks, Arroyo de los Corchos, *no. 1715.*

It is somewhat troublesome to distinguish the above new species of *Stigonema* from certain species of *Hassalia.* There are many filaments in both genera which do not show branching. Both have heterocysts very similar, being formed from an original cell of the filament, whereas in many species of the genus *Stigonema* for the most part the heterocyst is formed from a part of an original cell produced by a longitudinal division. It can readily be distinguished, of course, when the branching can be observed, and especially by the short, blunt, hormogoniferous branches. *Stigonema scytonematoides* seems closely related to *S. elegans* of this paper. The sheath is wider and lamellose, the cells are more nearly spheres in form, and the diameter of the filament is greater than in that species.

Stigonema tuberculatum sp. nov.

PLATE 21, FIGURE 55

Filaments 200–300 μ long, 14–18 μ diam. in oldest parts, crooked, irregular, and tuberculate; cells spherical, 1–4-seriate, olive-green, 5–7 μ diam.; sheath thin, close-fitting, hyaline.

Growing on rocks near Maricao, *no. 1030,* type.

The plants of this species have the peculiar habit of not readily wetting or absorbing water; seemingly waxy.

Stigonema opalescens sp. nov.

PLATE 22, FIGURE 58

Filaments moderately crooked, long-arcuate, smooth, 450–650 μ long, about 25 μ diam.; cells subspherical, mostly 4-seriate, 7–8.5 μ diam., bluish-green, homogeneous, protoplasmic connections distinct; sheath uniformly opalescent, even and smooth along the surface, ample; heterocysts very sparse; branching very sparse.

Growing on rocks near Maricao, *no. 1033,* type.

The long, arcuate, smooth filaments with few branches and the opalescent sheath are sufficient to distinguish this species of *Stigonema.* The division of cells is somewhat spasmodic, not uniform throughout the filament. It is a common occurrence that one, two, three, or four cells in a node in the body of the filament may be present.

Stigonema parciramosum sp. nov.

PLATE 23, FIGURE 59

Filaments 300–450 μ long, 23–27 μ diam., not tapering, branches very sparse, similar to the main filaments, not constricted at the base; cells compressed-spherical, 17–19 μ diam., one-half to two-thirds as long as the diameter, pale aeruginous, homogeneous, strictly uniseriate in the filament except where branches arise, contiguous or slightly separated when old; heterocysts fairly numerous, of the same shape and size as the cells; sheath thick, hyaline, homogeneous, subgelatinous.

Growing among other species of Myxophyceae, *e.g., Scytonema javanicum,* on lava north of Sabana Grande, *no. 921 a,* type.

This is a very distinct species of *Stigonema,* with relatively short, straight, and sparsely branched filaments containing a single series of subspherical to much compressed cells, a thick hyaline sheath, and conspicuous, large heterocysts, a combination of characters most nearly approached by *Stigonema elegans* and *S. scytonematoides,* both of this paper.

Hapalosiphon tenuis sp. nov.

PLATE 23, FIGURE 60

Creeping filaments very profusely branched unilaterally, giving rise to numerous, erect filaments producing a compact stratum; erect filaments slightly tapering upwards, 175–225 μ long, 6–7.8 μ diam. at the base, more or less branched near the base; trichomes 2.3–2.6 μ diam.; cells quadrate to 3.5 times as long as the diameter, homogeneous, blue-green, cylindrical to somewhat dolioform; sheath thin, firm, smooth, subgelatinous; heterocysts same shape and size as the cells, single or 2–3-seriate in the creeping filaments or in the lower part of the erect filaments.

Growing on serpentine rocks, forming a thin velvety stratum, north of Sabana Grande, *no. 943,* type; on bark, Utuado, *no. 1496.*

Hapalosiphon subgelatinosus sp. nov.

PLATE 23, FIGURE 61

Erect filaments numerous, sparsely branched, arising from a more or less creeping filament, 10–14 μ diam., 200–250 μ long, nearly straight and parallel, in part attenuated, adhering to each other somewhat by their subgelatinous sheaths into small fascicles; creeping filaments larger than the erect filaments; cells variable in shape and in size, cylindrical to dolioform, 5–10 μ diam., the constrictions at the dissepiments extending to the sheath, homogeneous, pale aeruginous; sheath hyaline, thick, homogeneous; heterocysts conspicuous, slightly yellowish brown, subspherical, mostly in the creeping filaments and in the lower part of the erect filaments, 8–10 μ diam.

Growing on limestone between Arecibo and Utuado, *no. 1476 f,* type.

ERRATA

In "NEW MYXOPHYCEAE FROM PORTO RICO," Memoirs of The New York Botanical Garden 7: 1–144. *pl. 1–23.* 1927.

Page 25. For "Growing in association with other—etc.," read: In depressions in limestone between Cabo Rojo and San German, N. L. Britton, *no. 1149a,* type.

Page 43. For "**rubriterricola**," read **rubroterricola.**

Page 45. Delete "Growing in a waterfall between Arecibo and Utuado, no. 1460, type."

Page 49. Under **Symploca roseola**, for the last part of the last line in the diagnosis, read: sheath rose pink.

Page 53. For "**Schizothrix rosea** sp. nov.," read SCHIZOTHRIX CHALYBEA **minor** var. nov.; and for "SCHIZOTHRIX THELEPHOROIDES **minor** var. nov.," read **Schizothrix rosea** sp. nov.

Page 54. For "MICROCOLEUS SOCIATUS **minor**," read SCHIZOTHRIX THELEPHOROIDES **minor** var. nov.

Page 81. Under **Scytonema multiramosum** in the second line of the diagnosis, for "1.5–2.5 μ," read 1.5–2.5 mm.

Pages 82, 83, 84, 85, 130, 132, and 134. For "**Hassalia**," or "*Hassalia*," read **Hassallia**, or *Hassallia.*

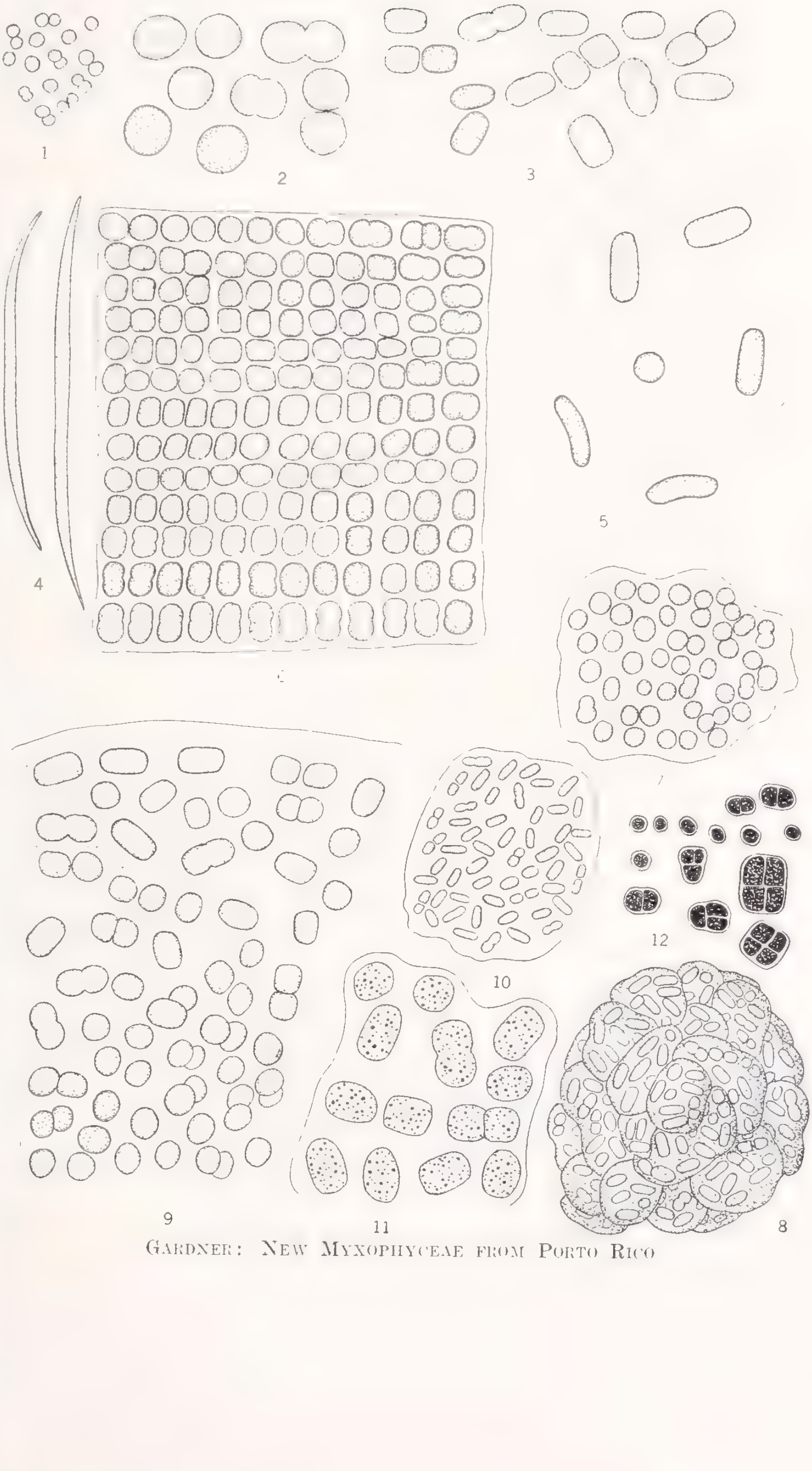
Page 86. Under **Tolypothrix amoena**, in first line of diagnosis, for "10–15 μ," read 10–15 mm.

Page 87. Under **Tolypothrix Willei**, for "in a pool in Jayuya," read: in a ditch between Utuado and Adjuntas.

Page 112. For "*rubriterricola,*" read *rubroterricola.*

PLATE 1

FIGURE 1. *Synechocystis primigenia*
A group of cells, showing stages in division ×1,500
“ 2. *Synechocystis Willei*
Small group of cells, showing stages in division ×1,500
“ 3. *Synechococcus intermedius*
A group of cells actively dividing ×1,000
“ 4. *Dactylococcopsis arcuata* ×1,000
“ 5. *Chroothece Willei*
A group of cells in longitudinal view except one in end view ×500
“ 6. *Merismopedia Willei*
A typical colony ×500
“ 7. *Aphanocapsa intertexta*
A small colony ×1,000
“ 8. *Aphanothece opalescens*
A small colony ×1,000
“ 9. *Aphanothece Richteriana major*
A fragment of a colony, showing a portion of the surface and interior ×1,000
“ 10. *Aphanothece bacilloidea*
A small colony, showing cells in various stages of division ×1,000
“ 11. *Aphanothece microscopica granulosa*
A few cells of a young colony ×1,000
“ 12. *Chroococcus cubicus*
A few normal cells in various stages of division forming colonies ×1,000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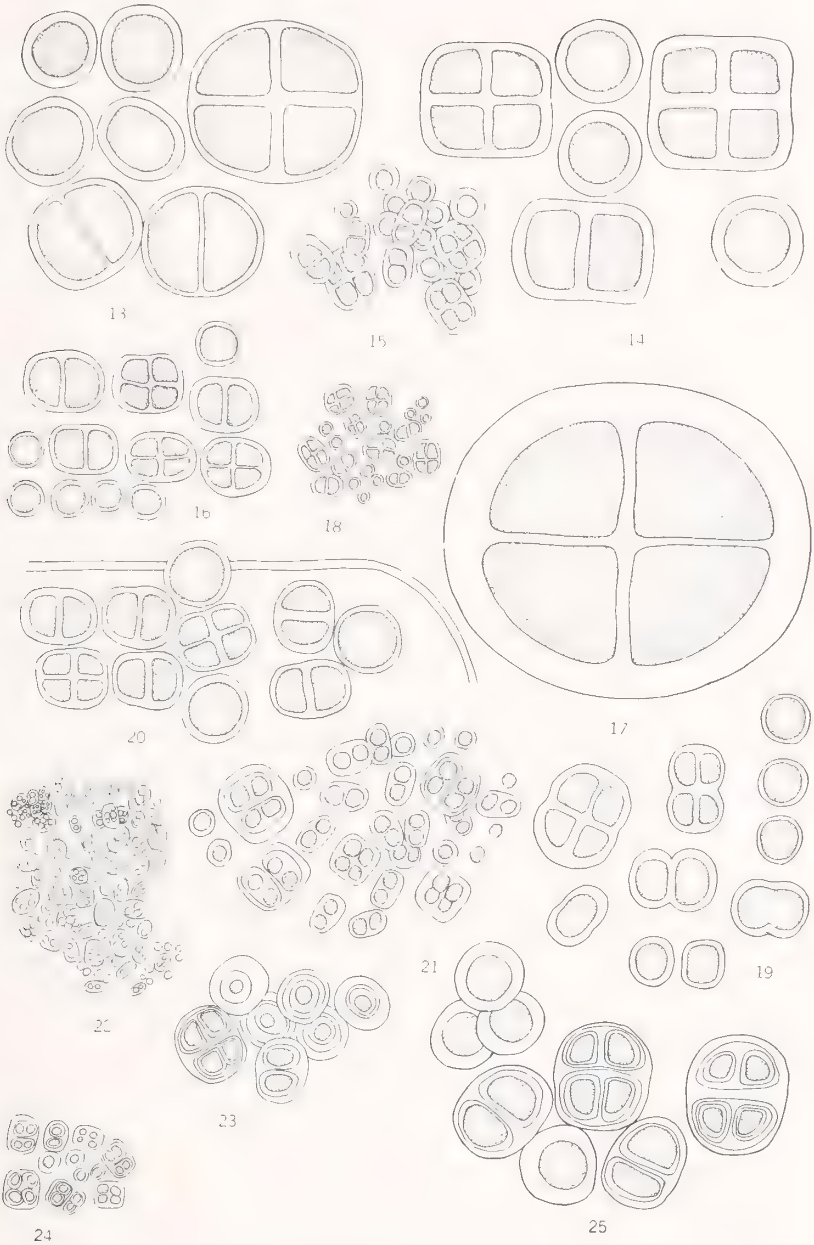
GARDNER: NEW MYXOPHYCEAE FROM PORTO RICO

PLATE 2

FIGURE	13.	*Chroococcus subsphaericus* A few typical cells and colonies	× 1,200
"	14.	*Chroococcus mediocris* Single cells and typical colonies	× 1,000
"	15.	*Chroococcus muralis* A small group of single cells and colonies	× 1,000
"	16.	*Chroococcus aeruginosus* A small group of single cells and colonies	× 1,000
"	17.	*Chroococcus giganteus occidentalis* A single colony of four cells, typical	× 500
"	18.	*Chroococcus minutissimus* A small group of typical cells and colonies	× 1,000
"	19.	*Chroococcus constrictus* A small group of cells, showing stages in division and colony formation	× 1,000
"	20.	*Chroococcus heanogloios* A small group of typical cells and colonies attached to a host plant	× 500
"	21.	*Gloeocapsa cartilaginea* A small colony	× 1,000
"	22.	*Gloeocapsa acervata* A small colony with young internal colony formation	× 1,000
"	23.	*Gloeocapsa livida minor* Typical single cells and colonies	× 1,000
"	24.	*Gloeocapsa calcicola* Typical single cells and colonies	× 1,000
"	25.	*Gloeocapsa ovalis* Typical single cells and colonies	× 1,000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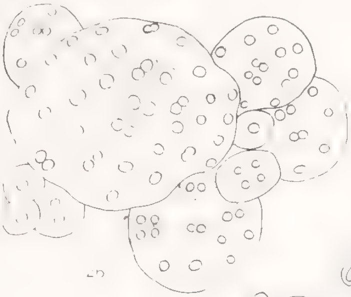
Gardner: New Myxophyceae from Porto Rico

PLATE 3

Figure 26.	*Gloeocapsa sphaerica* A group of colonies in various stages of development	×1,000
“ 27.	*Gloeocapsa quadrata major* A group of typical colonies	×1,000
“ 28.	*Gloeothece interspersa* A small group of typical cells and colonies	×1,000
“ 29.	*Gloeothece endochromatica* Cells and colonies with black differentiated teguments	×1,000
“ 30.	*Gloeothece parvula* Two small but typical colonies	×1,000
“ 31.	*Gloeothece opalothecata* A group of typical colonies	×1,000
“ 32.	*Gloeothece prototypa* A group of typical cells and colonies	×1,000
“ 33.	*Anacystis nigropurpurea* A group of young, developing colonies on the left and one colony with mature resting cells on the right	×500
“ 34.	*Anacystis nigroviolacea* Showing the colonies in various stages of development and one colony with mature resting cells escaping	×500
“ 35.	*Anacystis cylindracea* A single typical colony, showing typical cells and ample homogeneous tegument	×500



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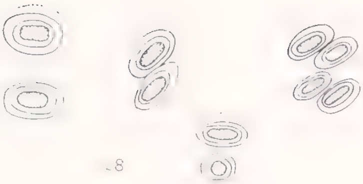

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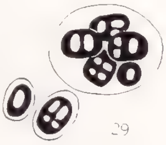

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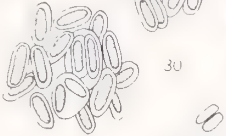

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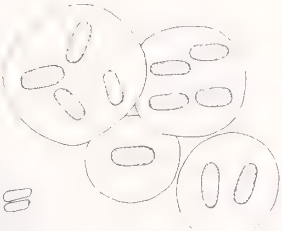

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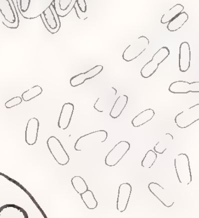

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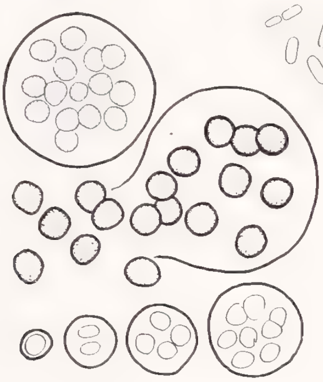

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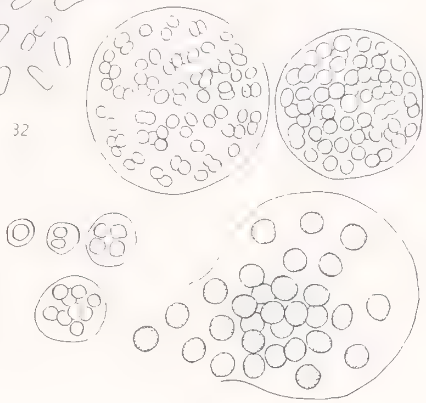

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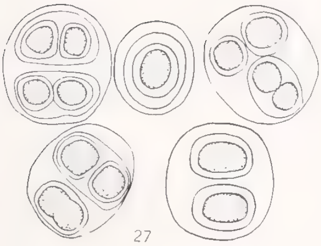

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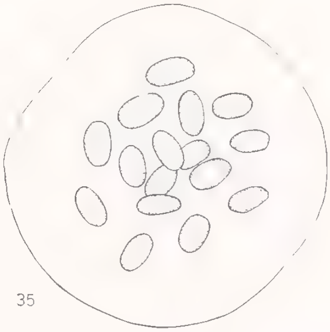

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GARDNER: NEW MYXOPHYCEAE FROM PORTO RICO

PLATE 4

FIGURE 36. *Anacystis compacta*
Two colonies. The one at the left in typical vegetative condition, the other at the right with mature resting cells ×500

" 37. *Anacystis distans*
A group of colonies in various stages of development ×500

" 38. *Anacystis magnifica*
A, mature resting cell; B, C, D, early stages in the development of the colony; E, a colony nearing maturity ×500

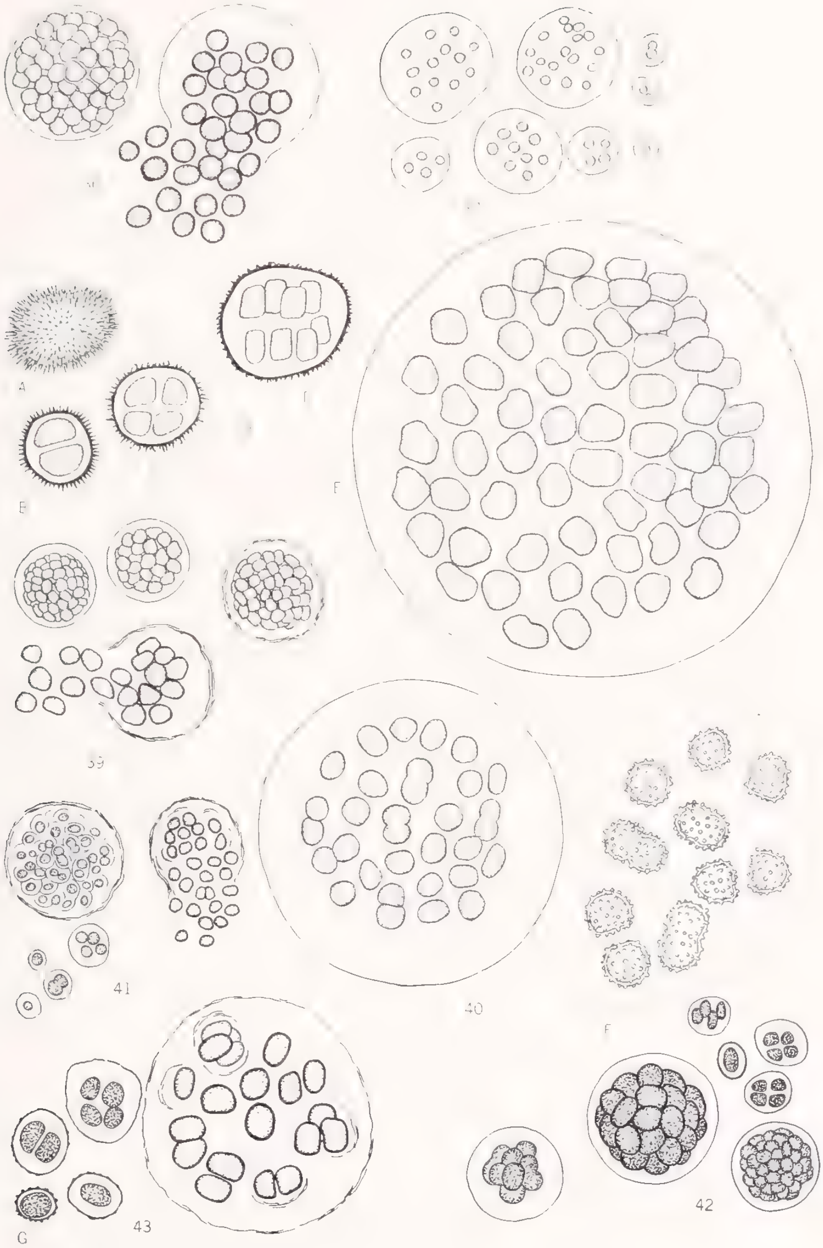
" 39. *Anacystis microsphaeria*
Showing mature resting cells below and disintegrating tegument ×500

" 40. *Anacystis amplivesiculata*
A single colony with rapidly growing cells to the left and F, a colony with mature resting cells ×500

" 41. *Anacystis gloeocapsoides*
Below, showing early stages in the development of the colony, a colony nearing maturity at the left, and a mature colony at the right ×500

" 42. *Anacystis nidulans*
A small group of colonies, the one in the center mature ×500

" 43. *Anacystis pulchra*
Early stages in the development of the colony at the left, a mature colony at the right ×500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Gardner: New Myxophyceae from Porto Rico

PLATE 5

FIGURE 44. *Anacystis Willei*
A colony almost mature at the left, mature colony with some resting cells germinating ×500

" 45. *Anacystis irregularis*
A group of colonies of various shapes, sizes and ages ×500

" 46. *Anacystis minutissima*
A group of colonies in various stages of development ×1,000

" 47. *Anacystis consociata*
A single typical colony 1,000

" 48. *Anacystis radiata*
A colony in median section view and germinating cells ×500

" 49. *Anacystis radiata major*
Stages in the development of the colony at the left and a colony nearing maturity at the right ×500

" 50. *Anacystis anomala*
Showing stages in the development of the colony from a single cell ×500

" 51. *Endospora rubra*
A group of cells and colonies in various stages of development ×500

" 52. *Endospora bicoccus*
A small group of cells in various stages ×1,000

" 53. *Endospora nigra*
In the two-celled, four-celled, and resting cell stages ×1,000

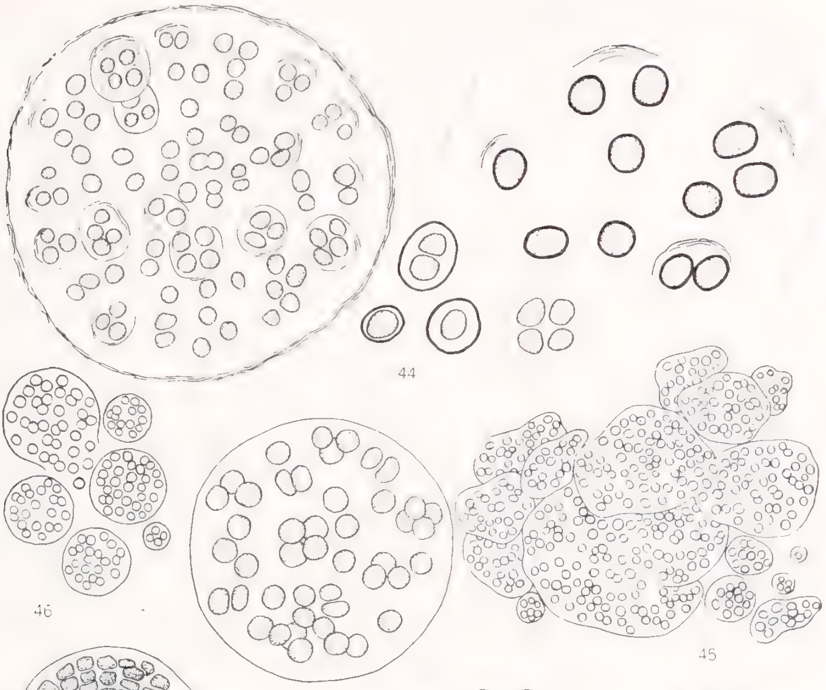
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PLATE 6

FIGURE 54. *Placoma Willei*
A surface view of a part of a mature colony × 500

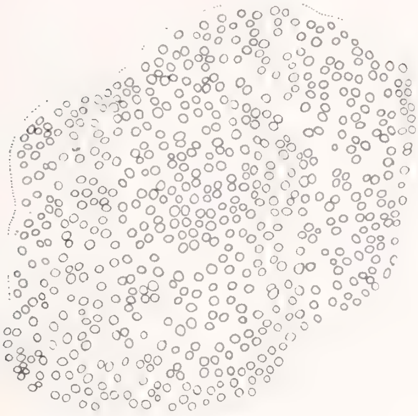
" 55. *Entophysalis chlorophora*
A section of a portion of a thallus perpendicular to the substratum × 500

" 56. *Entophysalis violacea*
A section of a portion of a thallus perpendicular to the substratum × 500

" 57. *Cyanothrix primaria*
A single typical young filament × 500

" 58. *Cyanothrix Willei*
A single typical young filament × 500

" 59. *Pleurocapsa epiphytica*
As seen in surface view in various stages of development below the line and in section view above the line × 500



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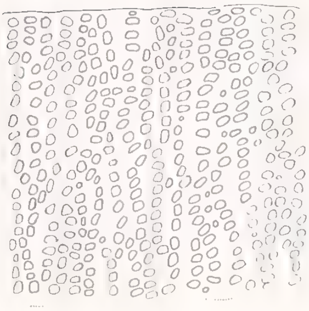

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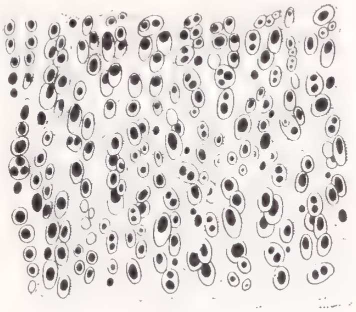

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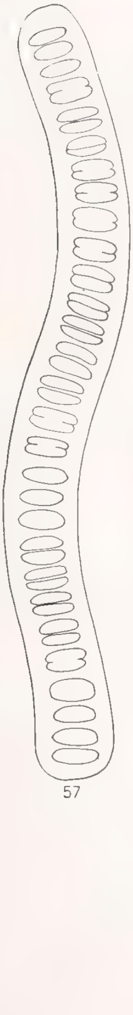

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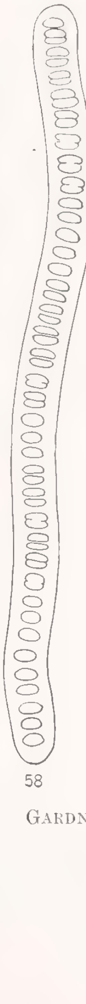

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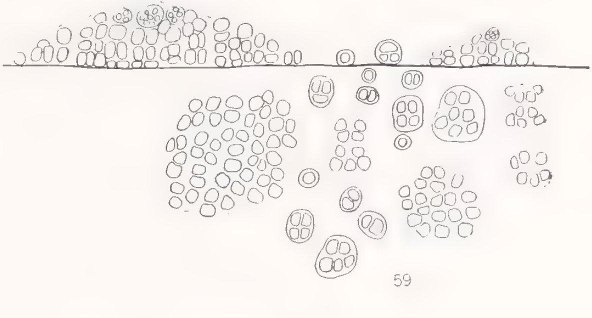

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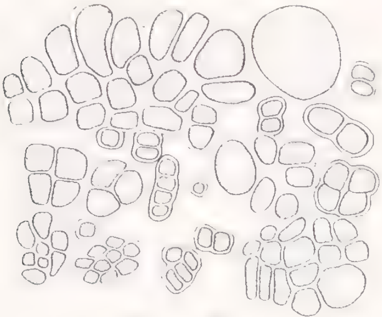
PLATE 7

Figure 60.	*Xenococcus Willei* A—a group of cells as seen in surface view; B—as seen in section view perpendicular to the host	×500
" 61.	*Chamaesiphon portoricensis* A group of plants representing different ages	×1,000
" 62.	*Chamaesiphon Willei* A group of plants representing different ages	×500
" 63.	*Oscillatoria tortuosa* Apical parts of two filaments	×1,000
" 64.	*Oscillatoria articulata* Apical part of a typical filament	×1,000
" 65.	*Oscillatoria articulata circinata* One whole plant	×1,000
" 66.	*Oscillatoria tenuis levis* Terminal portion of a single filament	×500
" 67.	*Oscillatoria Willei* Terminal portion of two filaments	×1,000
" 68.	*Oscillatoria chalybea insularis* Terminal portion of a typical filament	×1,000
" 69.	*Oscillatoria chlorina conica* Terminal portion of a typical filament	×1,000



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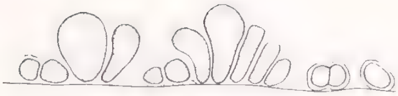

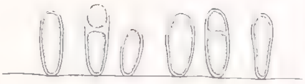

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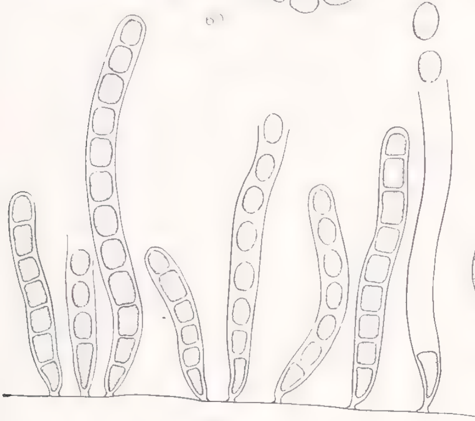

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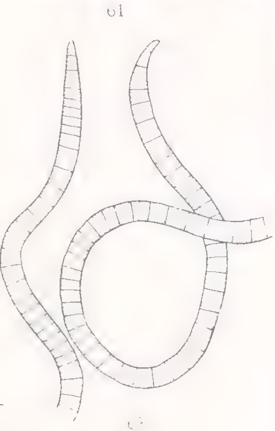

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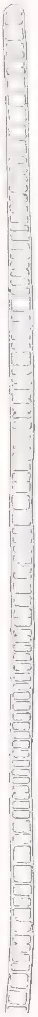

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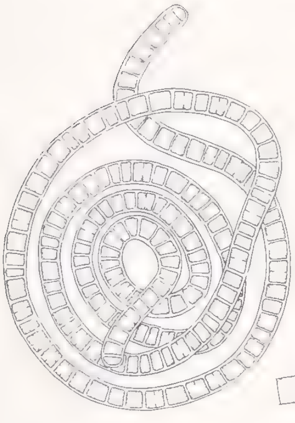

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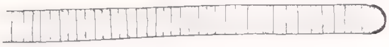

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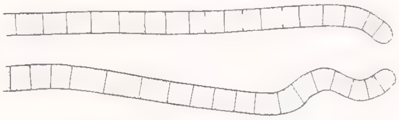

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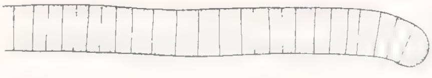

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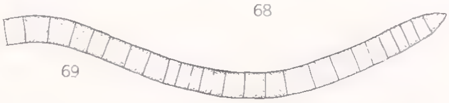

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PLATE 8

FIGURE 70. *Oscillatoria Earlei*
Terminal portion of a typical filament ×1,000
" 71. *Oscillatoria granulata*
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" 72. *Oscillatoria claricentrosa*
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" 73. *Oscillatoria obtusa*
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" 74. *Oscillatoria refringens*
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" 78. *Lyngbya scytonematatoides*
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" 79. *Lyngbya magnifica*
Terminal portion of a typical filament ×500
" 80. *Lyngbya Martensiana minor*
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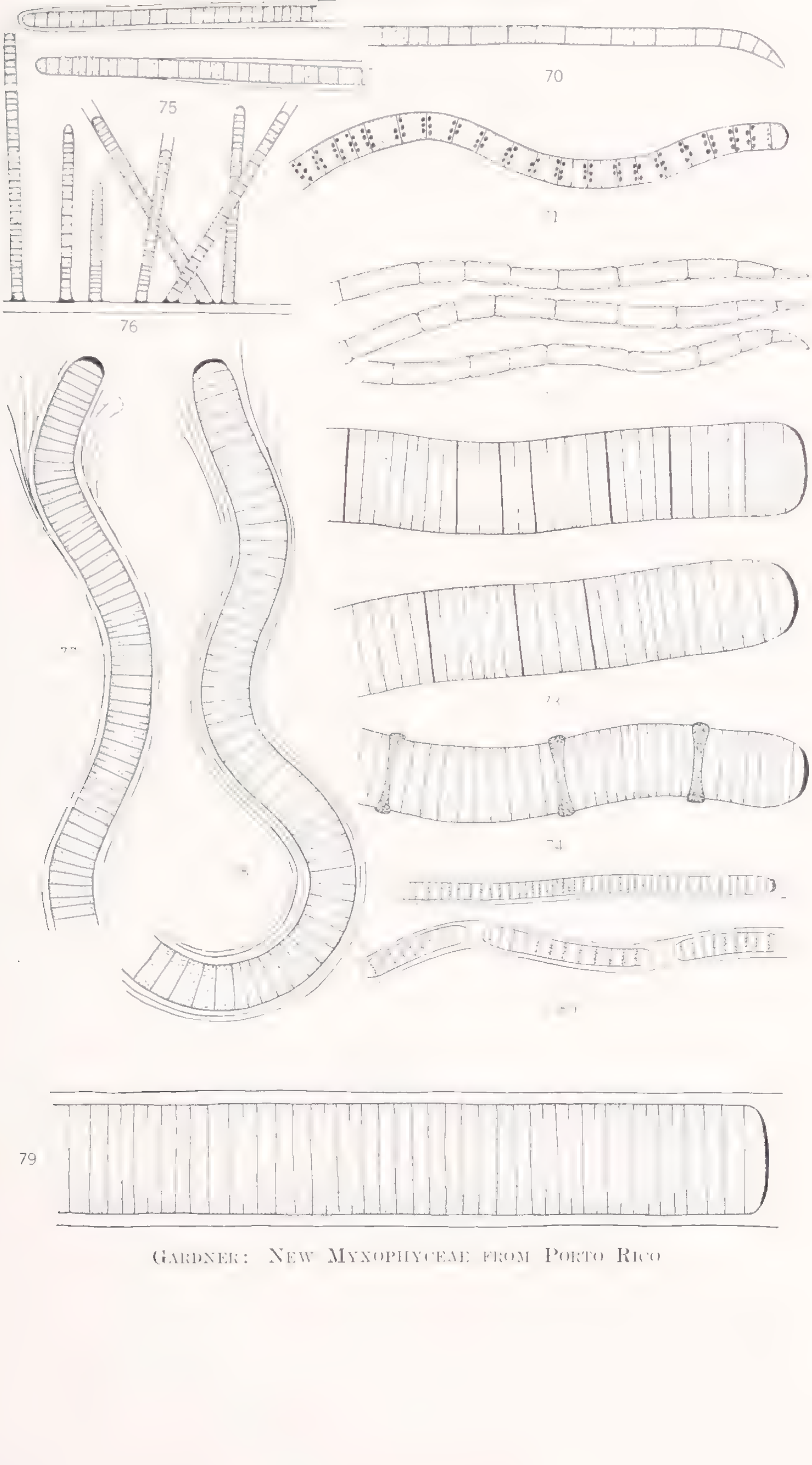

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PLATE 9

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" 82. *Lyngbya intermedia*
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" 83. *Porphyrosiphon robustus*
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" 84. *Phormidium mucosum*
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" 85. *Phormidium leptodermum capitatum*
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" 88. *Phormidium durum*
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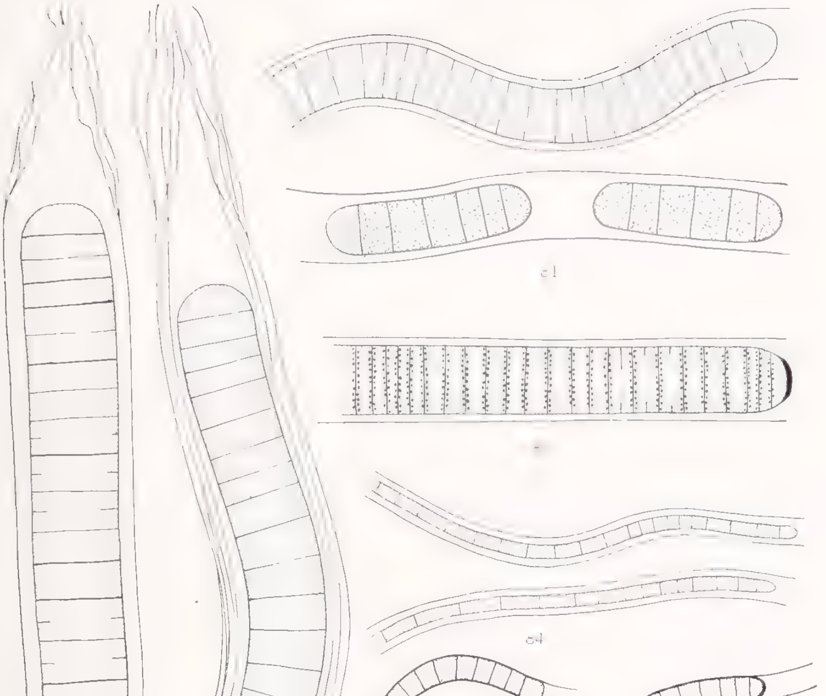

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PLATE 10

FIGURE	90.	*Plectonema flexuosum*	×500
“	91.	*Plectonema tenuissimum*	×1,000
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“	95.	*Hypeothrix longiarticulata* Terminal portions of two bundles, or filaments, one with a single trichome and the other with two showing long cells and acute apices	×500
“	96.	*Hypheothrix parciramosa* C—Terminal portions of two filaments D—Diagrammatic	×1,000
“	97.	*Hypheothrix symplocoides* Showing characteristic end of a filament with a single trichome	×500
“	98.	*Hypheothrix Willei* End of a filament, showing three characteristic trichomes	×500

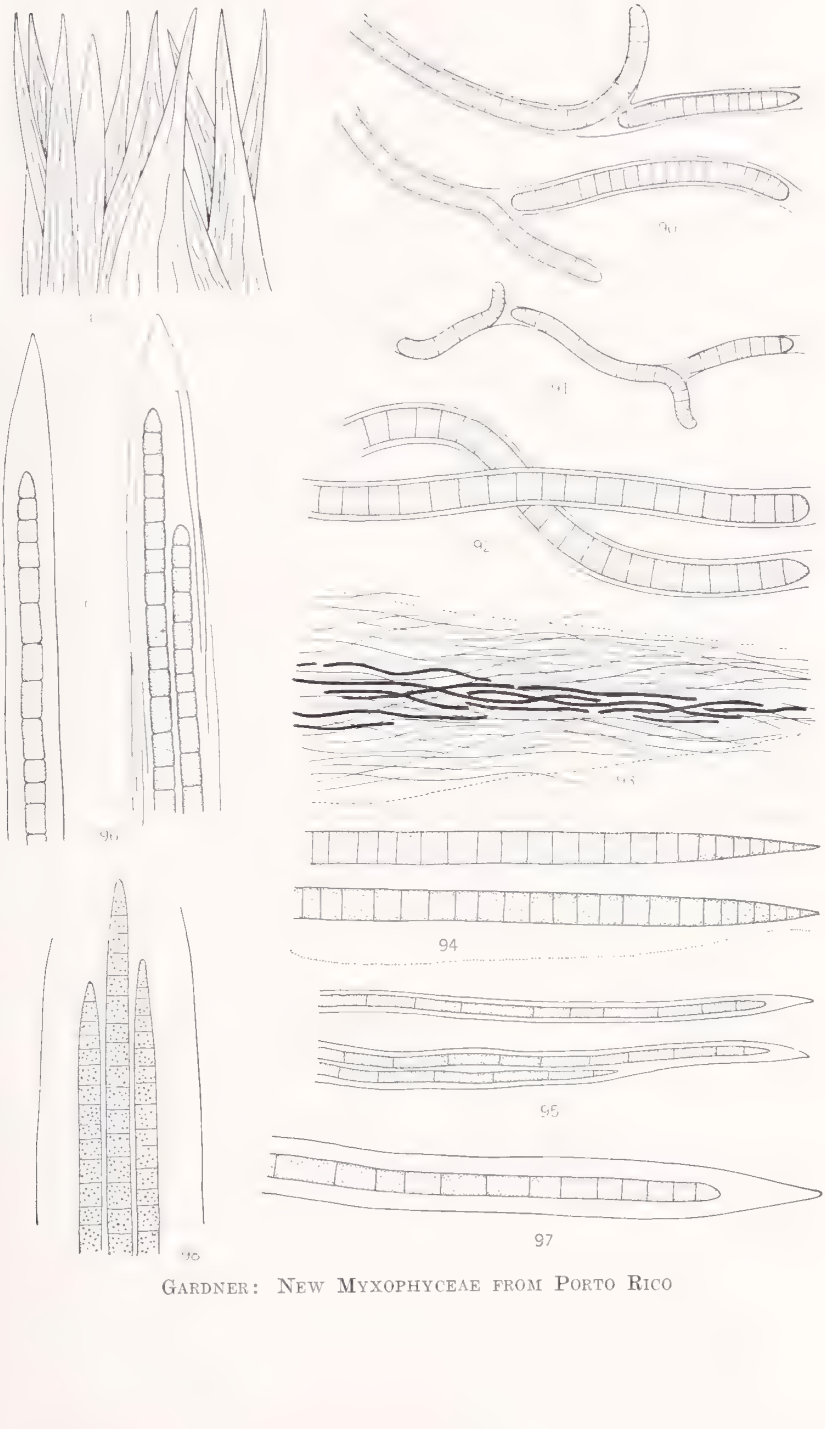
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PLATE 11

FIGURE 99.	*Schizothrix violacea*	
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“ 100.	*Inactis ecalcarea*	
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“ 1.	*Lyngbyopsis Willei*	
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“ 2.	*Microcoleus acutissimus*	×1,000
“ 3.	*Microcoleus amplus*	×1,000
“ 4.	*Microcoleus purpureus*	
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“ 5.	*Microcoleus paludosus acuminatus*	
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“ 6.	*Microcoleus sociatus minor*	
	Terminal portion of a single naked trichome	×1,000

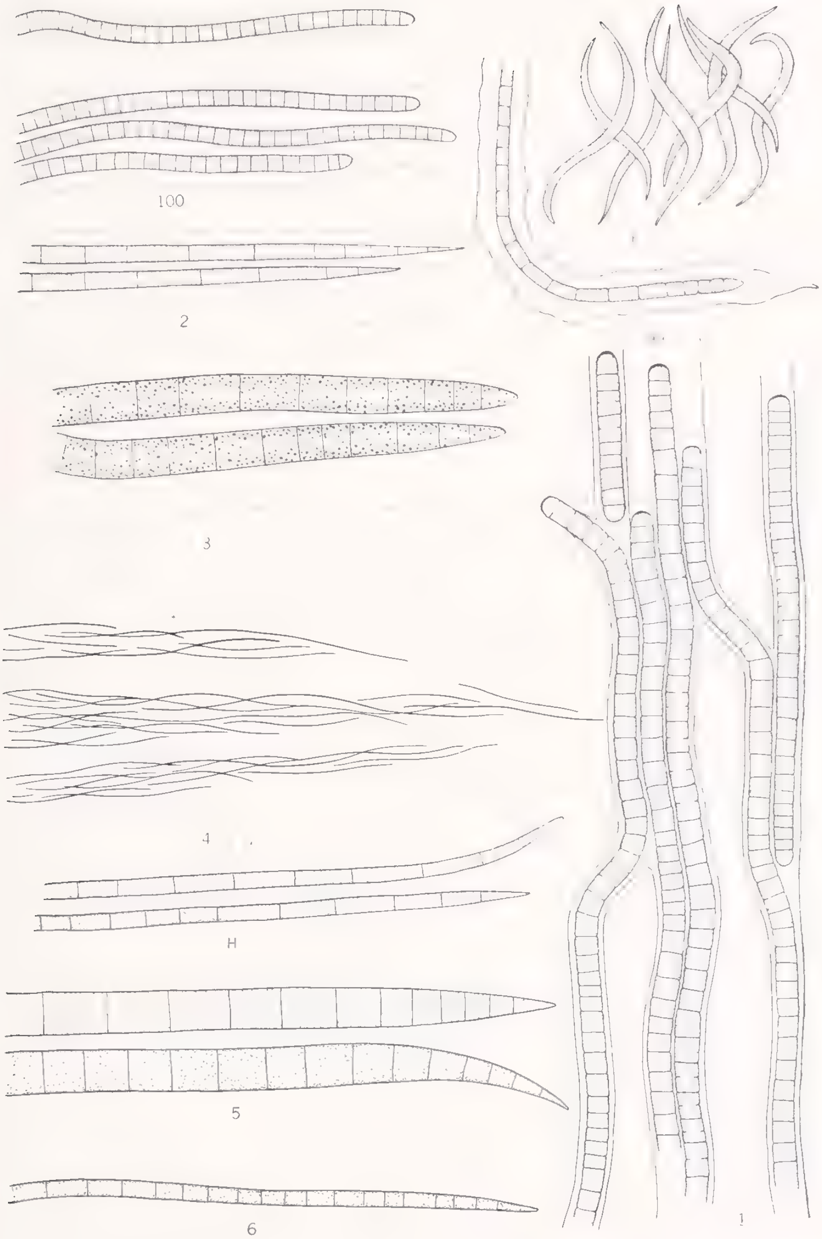
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PLATE 12

FIGURE 7. *Anabaena lutea*
J—A single young filament
K—A portion of a filament with catenate resting cells ×500

" 8. *Anabaena unispora*
A portion of a single filament with a single heterocyst and resting cell ×500

" 9. *Anabaena subtropica*
A portion of a filament with vegetative cells and resting cells at the right ×500

" 10. *Anabaena Willei*
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" 11. *Anabaena aeruginosa*
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" 12. *Anabaena delicatissima*
Portion of a filament with typical vegetative cells and heterocysts ×500

" 13. *Anabaena mediocris*
Portions of a filament, showing typical terminal cell, heterocysts, vegetative cells, and resting cells contiguous to the heterocyst ×500

" 14. *Anabaena portoricensis*
Portions of a filament showing typical terminal cell, heterocysts, vegetative cells, and resting cells contiguous to the heterocyst ×500

" 15. *Nodularia Willei*
Portion of a typical filament, showing vegetative cells, heterocysts, and resting cells ×500

" 16. *Nodularia epiphytica*
Portion of a typical young filament ×500

" 17. *Leptochaete tenella*
Portions of two filaments, the one above with gonidia at the base ×2,000

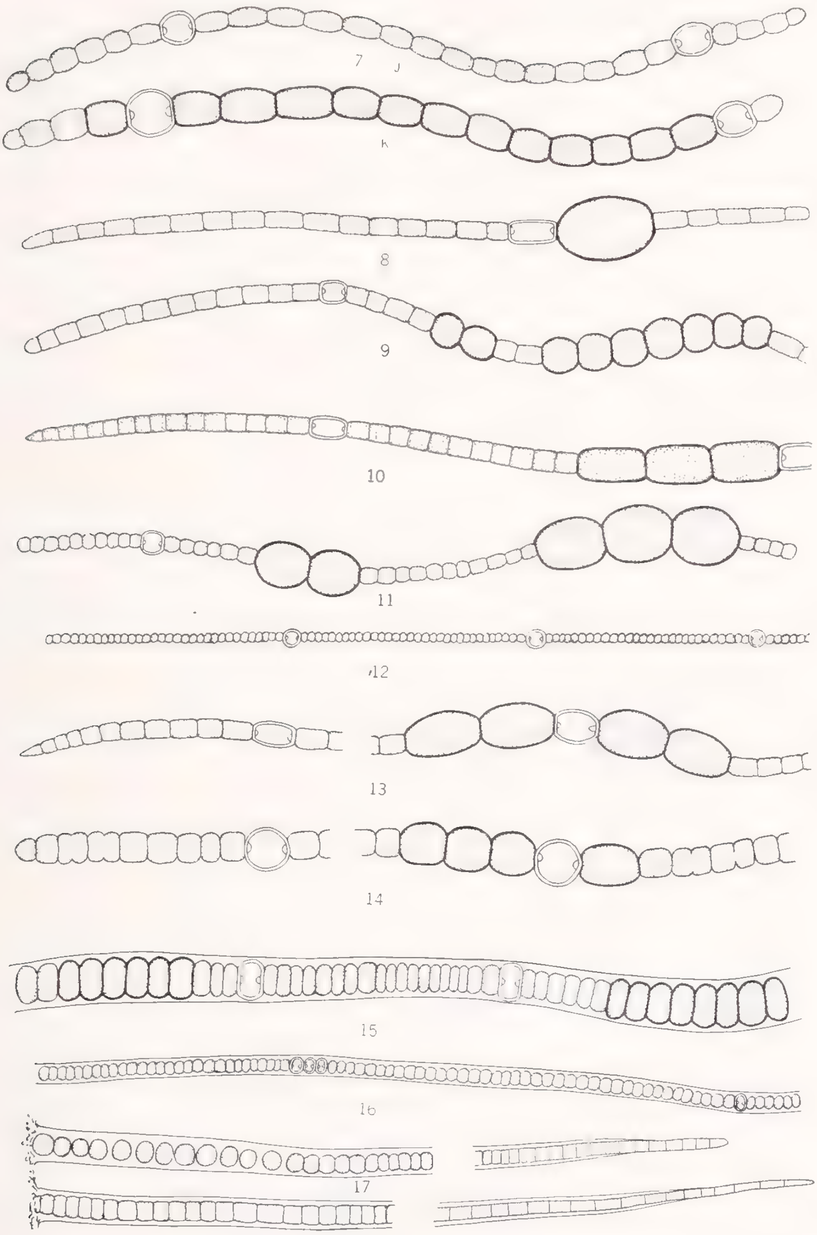
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PLATE 13

FIGURE 18. *Calothrix conica*
Portion of a single filament, showing the apex and the base........ × 1,000
" 19. *Calothrix simplex*
Portion of a single filament, showing the apex and the base........ × 250
" 20. *Calothrix tenella*
Two typical young filaments........ × 500
" 21. *Calothrix linearis*
Portions of a typical filament, showing the base and apex........ × 500
" 22. *Calothrix evanescens*
Two typical young filaments........ × 500
" 23. *Calothrix simulans*
Two typical filaments attached to the host........ × 500

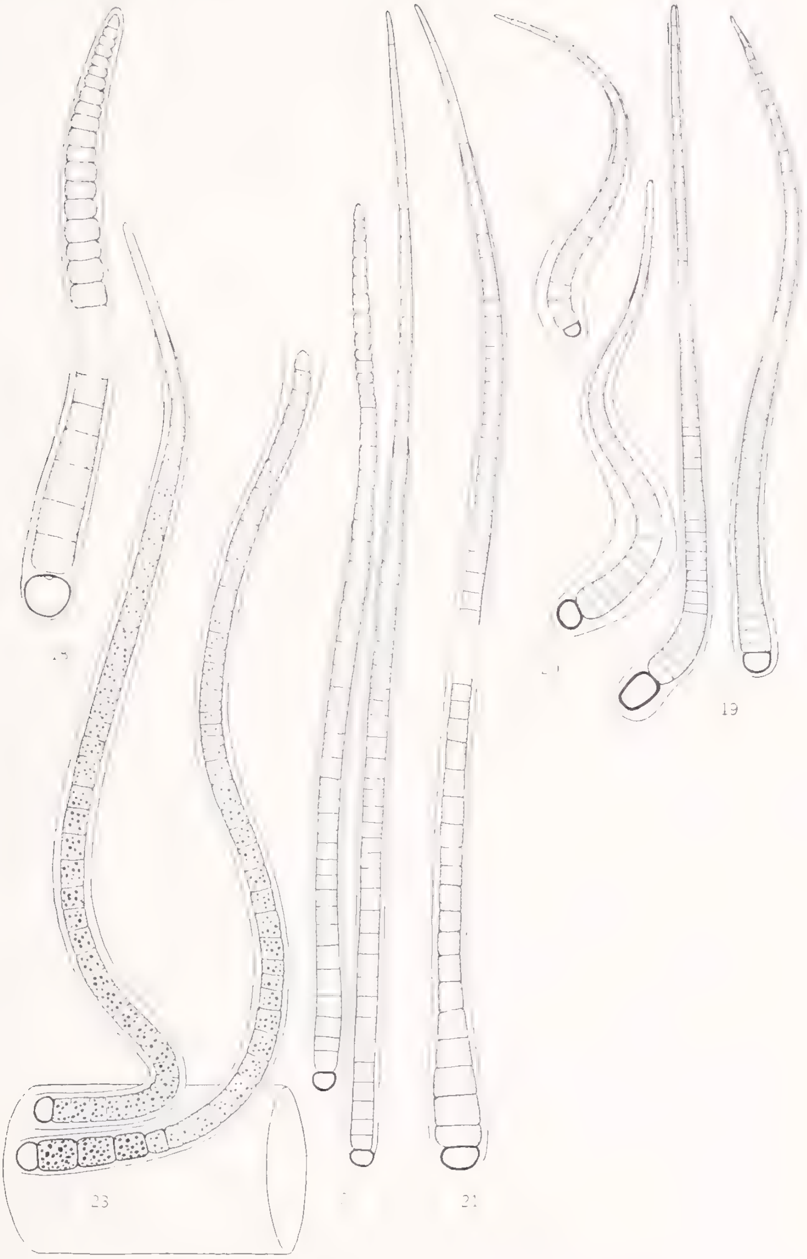

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PLATE 14

FIGURE 24. *Dichothrix Willei*
A small group of filaments.. 500
" 25. *Rivularia (Gloeotrichia) flagelliformis*
To the left, portions of typical filaments, to the right, portion of a filament showing one resting cell or spore.. 500

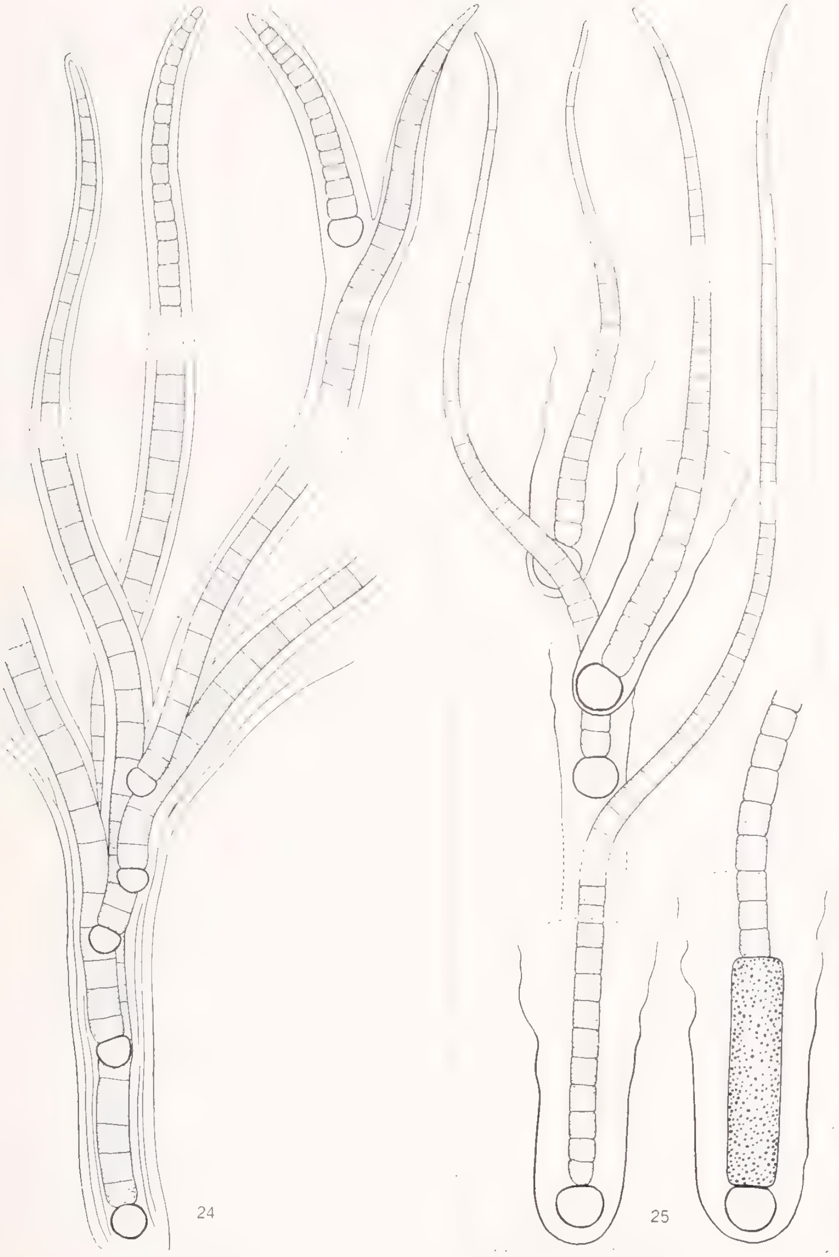

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PLATE 15

FIGURE 26. *Scytonema evanescens*
Portion of a filament, showing the branching in the upper younger part and the disappearance of the cells below ×250

" 27. *Scytonema capitatum*
To the left, a single young filament, showing a branch under a heterocyst; L, showing typical geminate branching and capitate ends ×250

" 28. *Scytonema longiarticulatum*
A single typical filament with lamellose sheath below, younger above, with geminate branching ×250

" 29. *Scytonema subgelatinosum*
Portions of filaments showing variations in character of the cells in different parts ×250

" 30. *Scytonema variabile*
Below with single branching, above with geminate branching 250

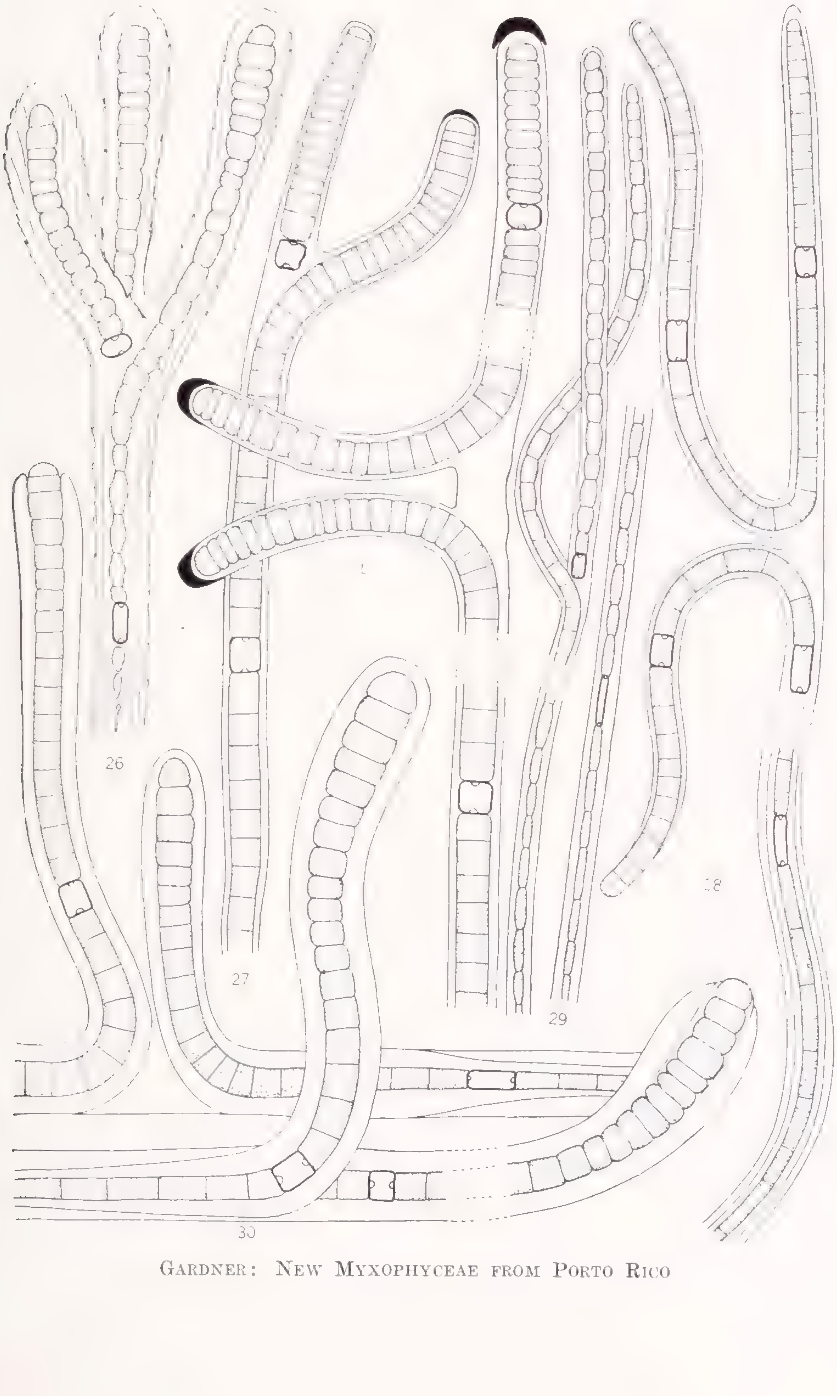
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PLATE 16

FIGURE 31. *Scytonema magnum*
Portions of typical filaments, showing geminate branching to the right and a portion of the older part to the left ×250

" 32. *Scytonema punctatum*
Portion of a typical filament, showing the punctate nature of the sheath ×250

" 33. *Scytonema pulchellum*
To the left, portion of a filament, showing single and geminate branching; to the right, M, portion of an older filament ×250

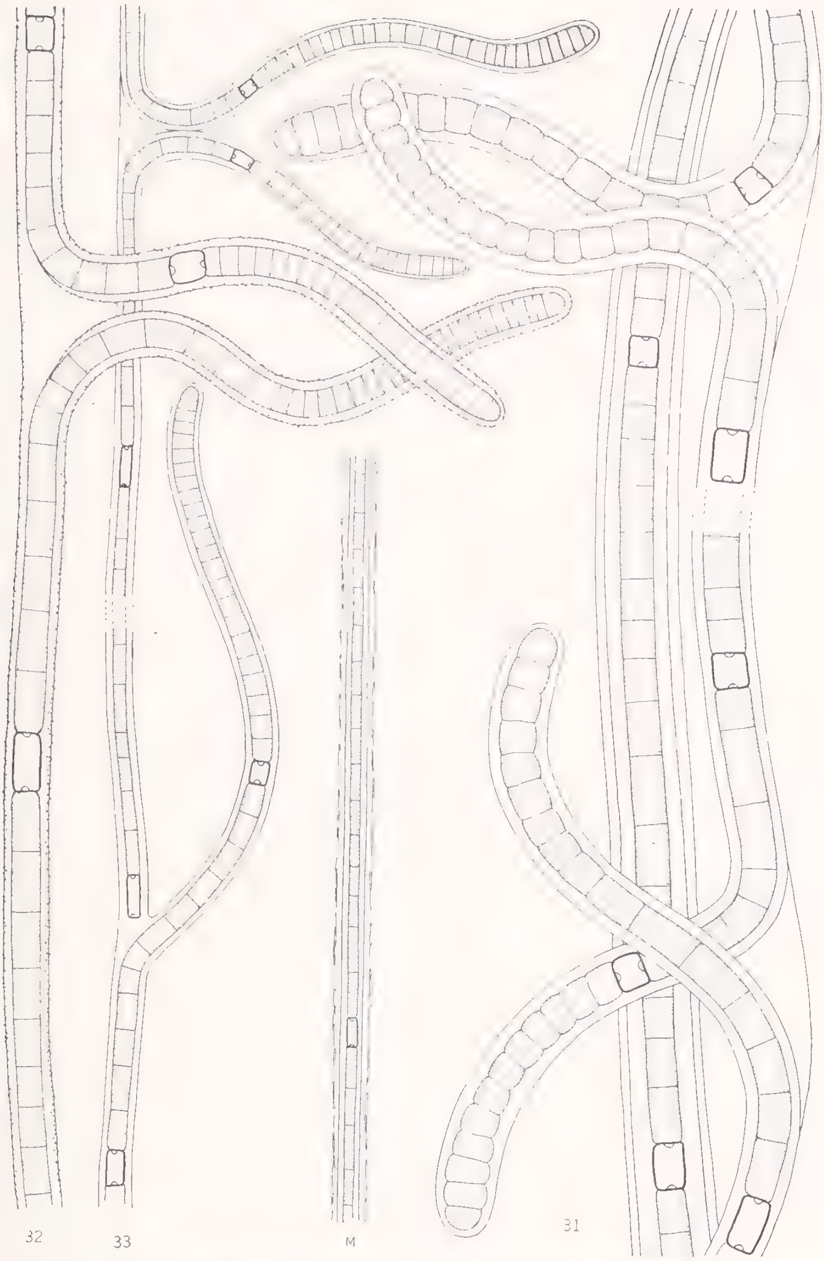

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PLATE 17

FIGURE 34. *Scytonema catenatum*
Apical portions of two filaments ×250
" 35. *Scytonema lyngbyoides*
Terminal portion of a filament with typical geminate branching ×250
" 36. *Scytonema tenue*
Portion of a typical filament with geminate branching ×250
" 37. *Scytonema spirulinoides*
Portion of a typical filament ×250

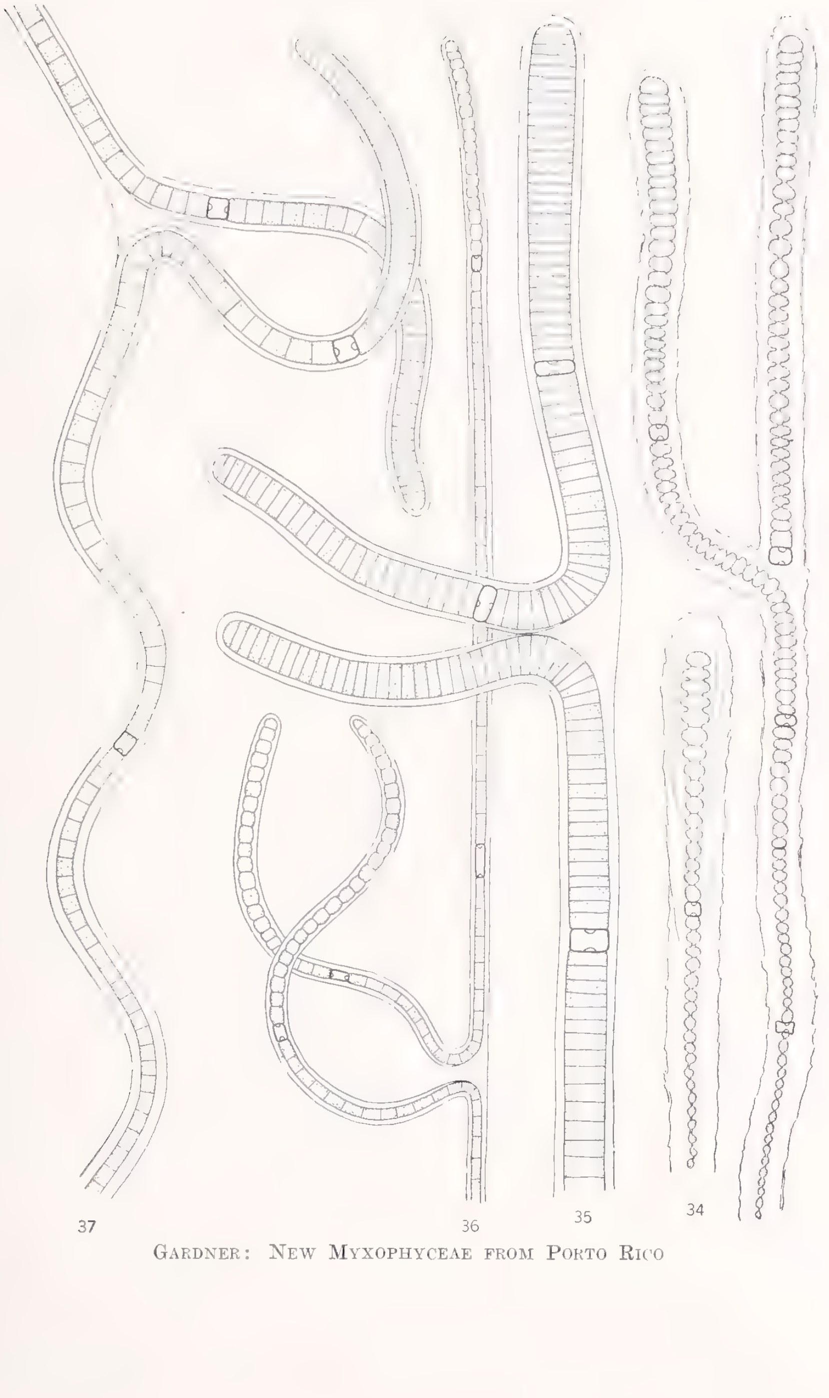

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PLATE 18

FIGURE 38. *Scytonema tenellum*
Portion of a plant, showing geminate branching...... ×250
“ 39. *Scytonema multiramosum*
Portions of a typical filament.. ×250
“ 40. *Hassalia brevis*
Portions of typical young filaments.................................. ×250
“ 41. *Hassalia granulata*
Portions of typical filaments.. ×250

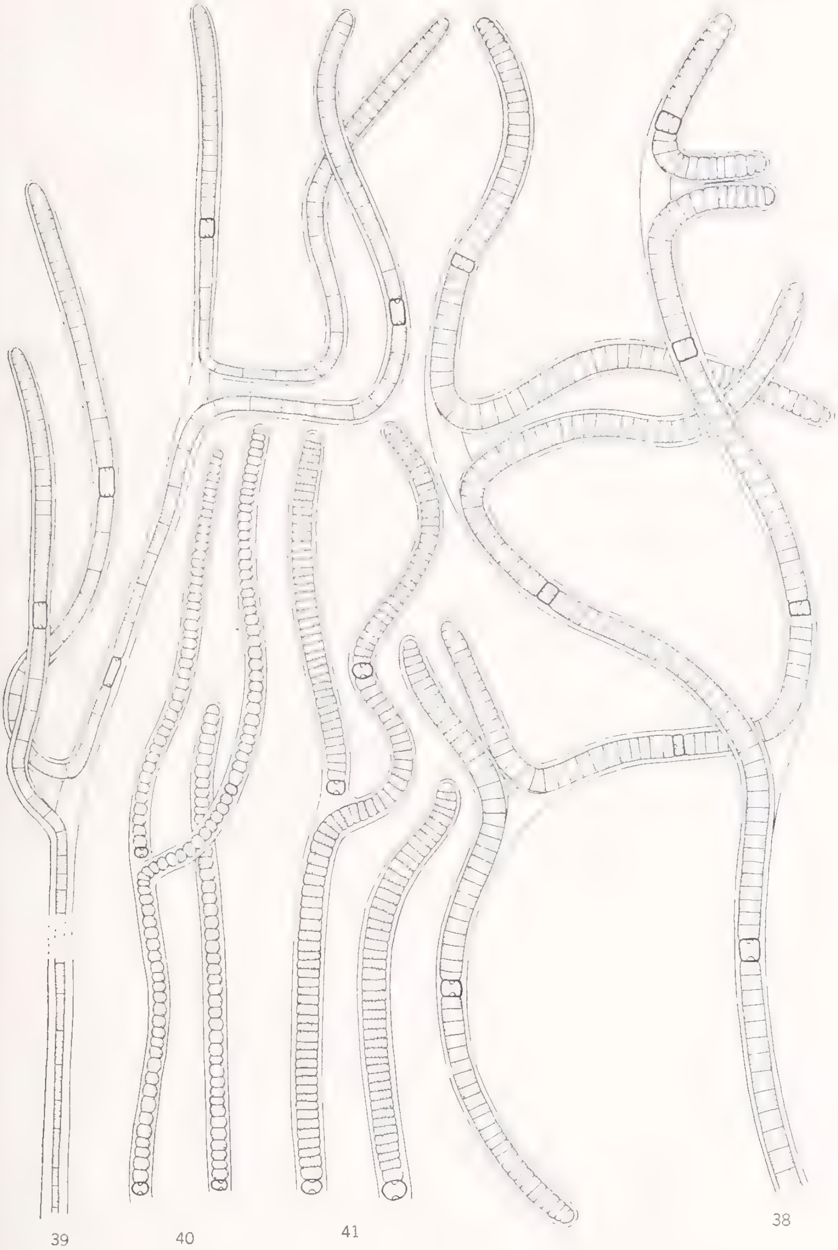

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PLATE 19

FIGURE 42. *Hassalia heterogenea*
Portion of a filament, showing single and geminate branching, the latter occurring very rarely ×250

" 43. *Hassalia discoidea*
Upper portion of a typical branching filament ×250

" 44. *Hassalia scytonematoides*
Upper portions of typical filaments in good vegetative condition ×250

" 45. *Hassalia rugulosa*
Upper portion of a typical filament with roughened sheath ×250

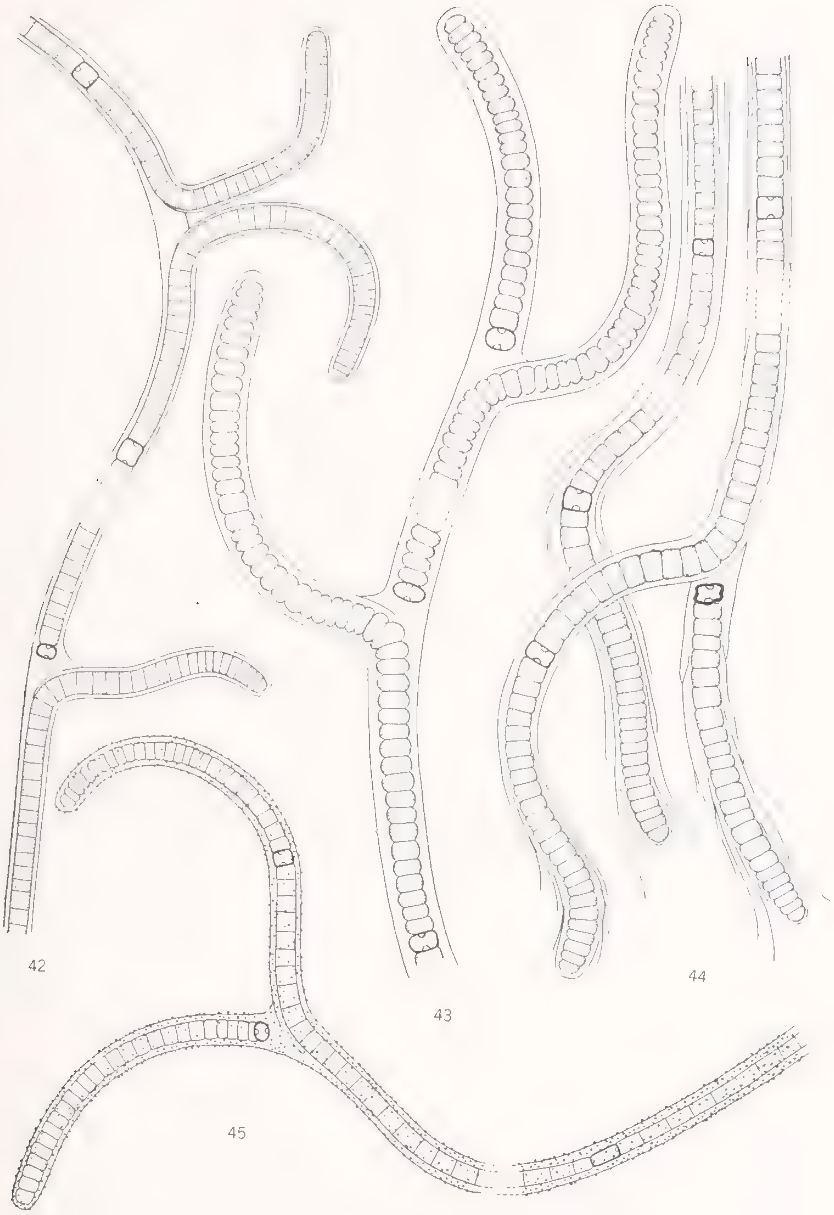

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PLATE 20

FIGURE 46. *Hassalia fragilis*
Upper portions of typical filaments × 500
" 47. *Tolypothrix papyracea*
Upper portion of a typical filament × 500
" 48. *Tolypothrix amoena*
Portions of a filament, showing the character of the cells in different parts × 250
" 49. *Tolypothrix robusta*
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" 50. *Tolypothrix Willei*
Portions of a filament, showing the character of the cells in different parts × 250
" 51. *Stigonema elegans*
A filament, showing typical vegetative branching, above, and a portion showing hormogoniferous branching, below × 250

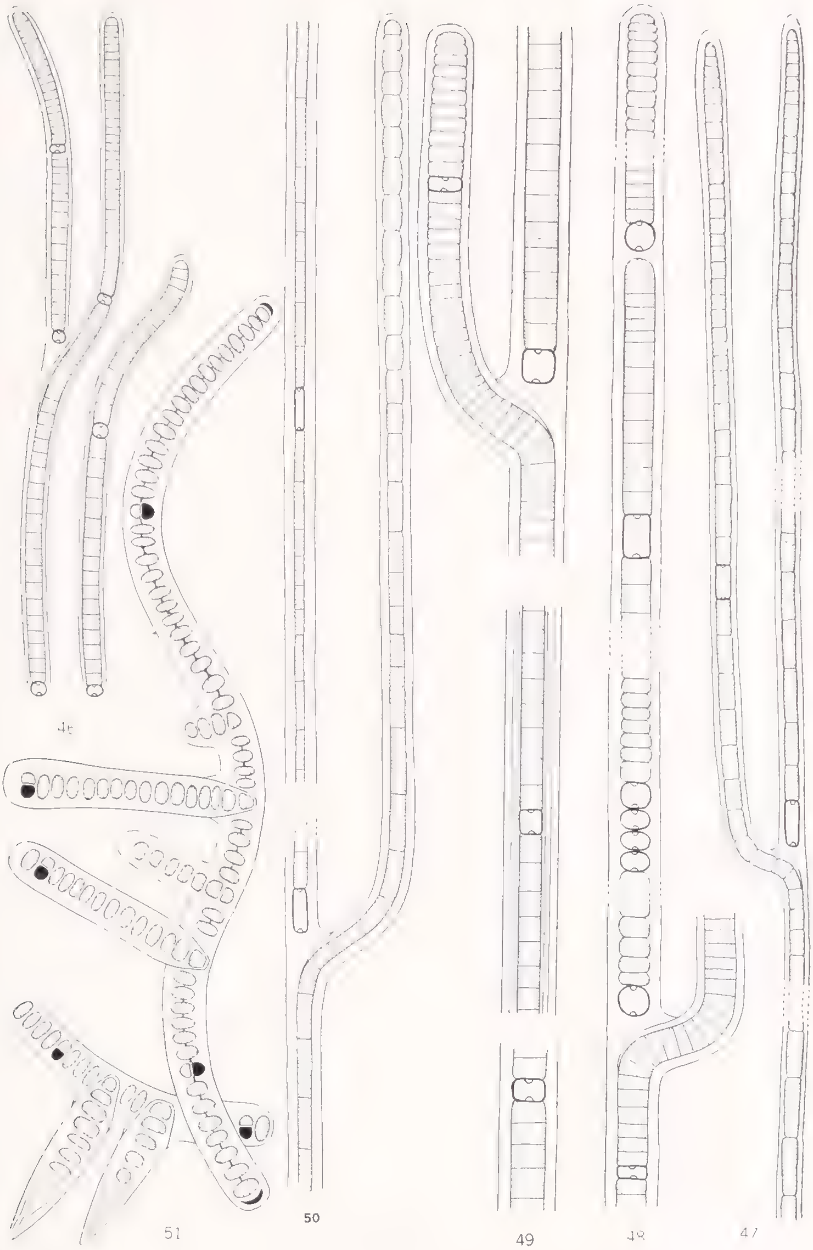
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PLATE 21

FIGURE 52. *Stigonema congestum*
The younger parts of a typical plant ×500
" 53. *Stigonema cornutum*
To the right, a typical plant, showing hormogoniferous branches; to the left, a typical older plant free from hormogoniferous branches ×250
" 54. *Stigonema ramosissimum*
Upper part of a typical plant ×250
" 55. *Stigonema tuberculatum*
Upper part of a typical plant ×250

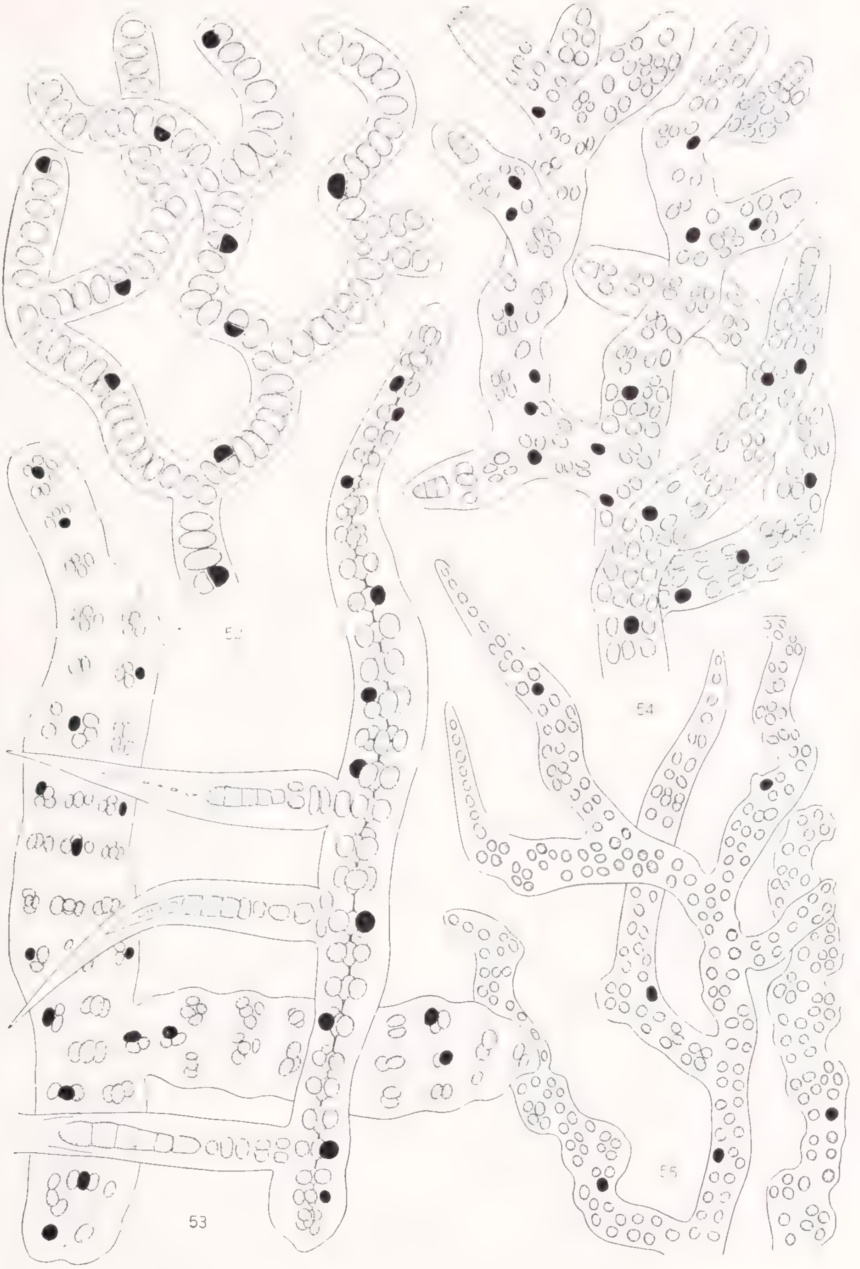

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FIGURE 56. *Stigonema spiniferum*
Portion of a typical plant with hormogoniferous branches and, T, a cross-section × 250

" 57. *Stigonema scytonematoides*
Portion of an older filament with a single vegetative branch and, N, apical portion of a branch, showing the character of lamellation of the tegument × 250

" 58. *Stigonema opalescens*
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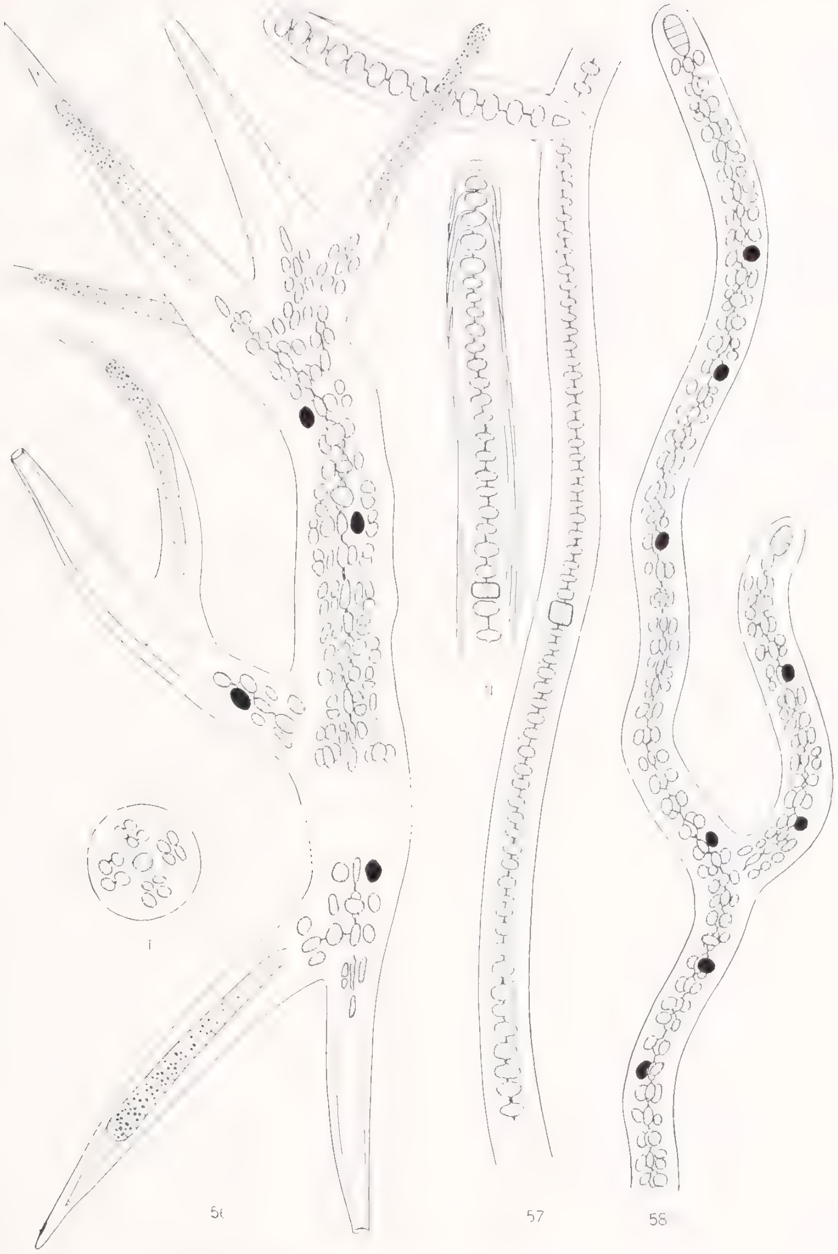

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PLATE 23

FIGURE 59.	*Stigonema parciramosum*	
	Upper portion of a typical plant	×250
" 60.	*Hapalosiphon tenuis*	
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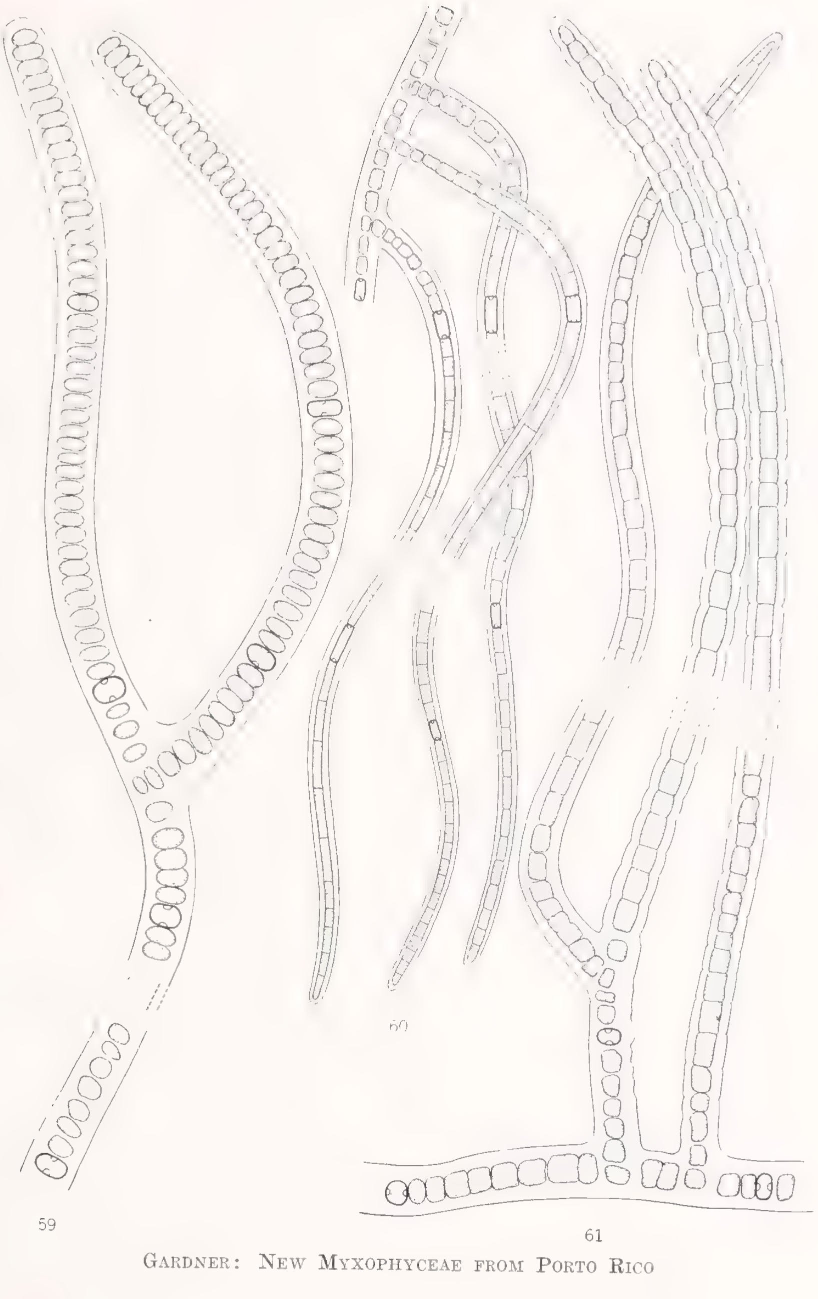
" 61.	*Hapalosiphon subgelatinosus*	
	Parts of a typical plant	×500



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Inactis **ecalcarea**, 54

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THE FLOWER BEHAVIOR OF AVOCADOS*

A. B. Stout

(WITH PLATES 24–28 AND CHARTS 1–10)

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In avocados the development of the two sexes in the hermaphrodite flowers is so regulated that the many flowers open on the entire tree function only as females during certain hours of the day and only as males during certain other hours of that same day. This alternation of the sexes for the entire tree continues day after day with a regularity that greatly limits or even entirely prevents both the self-pollination of individual flowers and pollination from one flower to another (close-pollination) on the same tree or on different trees of the same clonal variety.

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* Avocados or alligator pears are evergreen trees of the laurel family (Lauraceae) indigenous to tropical America. Those in cultivation at the present time embrace at least three somewhat distinct races derived evidently from what has been considered as two somewhat closely related species of the genus *Persea*. Apparently avocados were grown during early pre-Columbian time as an important food crop in Central America and Mexico with later introduction into portions of South America and the West Indies. More recently their culture has spread into various tropical countries of the Old World and particularly has their culture become an important horticultural industry in Florida and California, with promise of much further development.

But what is still more remarkable, certain plants (individual seedlings and clonal varieties as such) are female during the hours of the day when other plants are male and then there is a reversal of sex in each for other hours of that same day. These reciprocating changes in sex provide chances for mutual cross-pollination between certain plants.

The flowers are perfect, relatively simple, and very uniform in structure throughout the species or group of species represented in the cultivated avocados. The adaptation for cross-pollination is accomplished by physiological regulation. The daily rhythmic alternation of sexes (synchronous dichogamy) for the entire plant and the reciprocation of these changes in certain groups of plants reach a perfection of physiological regulation in avocados that is unapproached, as far as is now known, in any other group of plants.

How synchronous dichogamy is achieved in avocados

The manner in which synchronous dichogamy is accomplished in avocados may be explained by tracing the events in the behavior of the flowers of a single tree throughout an entire day during a period of favorable weather. For this purpose a tree of the Taylor variety (a clonal variety) may be selected.

In the hours of early morning no flowers are open anywhere on the tree but during the early forenoon flowers begin to open here and there in the various clusters of flower buds all over the tree. In the opening of a flower, the six leaf-like segments of the perianth separate and bend outward. The two sets of six outer and three inner stamens follow and when the flower is fully open these stand nearly at right angles to the main axis of the pistil as seen in the open flowers shown in PLATE 24. This leaves the pistil standing erect, alone, conspicuous and fully exposed, with the slightly enlarged end (the stigma) white, fresh and soon ready to receive pollen. Nectar appears as a glistening film over the surface of the inner set of three nectaries, which stand from between the inner set of stamens. Now bees and other insects seeking nectar can scarcely fail to brush against the stigma of the pistil. The pistil is ready for pollination but no pollen is being shed from the stamens of the flower. The flower is for the time being functioning only as a female.

Directing attention to the numerous flowers open on this tree of the Taylor variety during this forenoon, one finds that all the flowers are in the same condition as the flower just described. No flowers are shedding pollen. All the flowers have the pistils ready for pollination. The entire tree functions as a female only and this condition continues throughout the entire forenoon.

About midday this set of flowers closes without having shed pollen. In doing this the perianth segments fold inward over the pistil until the flower is completely and tightly closed (see at 3 in PLATES 25 and 26. Thus an entire set of flowers, numbering for a large tree in the maximum of blooming more than a thousand, has been open and in the female stage during several hours of the forenoon and during midday these flowers have all closed almost in unison.

During the hours of midday and while the flowers which were open during the forenoon are in the final processes of closing, the flowers of *another* set begin to open. To a casual observer it would doubtless appear that the same flowers open in the forenoon merely continue open during the afternoon. In fact unless individual flowers are tagged for identification in further observation the complete midday shift of sets of flowers would probably not be discovered even under rather close observation. In the only observations on flower behavior in avocados published previously to those of the writer (Nirody, 1922) this shift of sets of flowers was not observed for any of the varieties that have the same daily sequence as the Taylor variety.

The flowers of the set opening for the afternoon are distinctly different in appearance from the set open during the forenoon (see PLATE 25). The stamens are noticeably larger and somewhat longer. The inner three stand erect in the middle of the flower around and overtopping the pistil. The end of the pistil is frequently dark colored and sometimes it is shriveled and dead. The outer set of six stamens stand at an angle of about 45°. Not long after these flowers are open, pollen begins to be shed.

The pollen is ingeniously lifted out of each of the four chambers of an anther by a spoon-shaped valve that opens quite like a trap door and bends upward. A somewhat sticky mass of pollen is gently held within the infolded margin of each valve, somewhat as one might hold a ball of popcorn in an upraised hand. Thus the nine rod-shaped stamens of each flower stand bristling in different directions with pollen exposed in several directions from their summits (see 4 in PLATES 25 and 26). Below at the base of the outer set of stamens and between the stamens, a set of short-stemmed dome-shaped nectaries excrete thick films of nectar. In their efforts to obtain this nectar bees and other insects climb over the stamens, push in between them and their hairy bodies become more or less smeared with the sticky pollen. But if pollen is not carried away by insects the sticky substance about and between the grains hardens and binds the pollen grains of each valve into a dry caked mass which then soon falls to the ground.

A careful census of the many flowers open on the Taylor tree during the afternoon will reveal that they are all in the same condition. They all shed pollen, the maximum of shedding being some time during the afternoon. Late in the afternoon these flowers close never to open again.

Thus, during the hours of daylight of a single day, two different sets of flowers open and close on a tree of the Taylor variety. The flowers which are open during the forenoon function only as females, those open during the afternoon function as males.

The differences in these two sets of flowers, and their relations to each other, become clear when the normal life-history or cycle of a single set is traced. The set which is open during the forenoon closes around midday and remains closed during that afternoon, the night following, and the next forenoon. In normal flower-behavior a set of flowers is open for the first or female opening during the forenoon of each day and is open for the second or male opening on the afternoon of the following day. There are two distinct and separate periods of anthesis, a condition which may be designated as *dianthesis.* Between the two periods of opening the set is closed for an interval of about twenty-four hours and the entire time from the beginning of the first opening to the end of the second opening (the cycle of dianthesis of the set) covers slightly less than thirty-six hours.

The sequence of sets continues regularly under favorable weather conditions and brings two different sets into opening each day. The forenoon set is open for the first or female opening and will open again on the afternoon of the following day to shed pollen. The afternoon set has had the first opening during the forenoon of the day before. Each flower is perfect, it has two distinct periods of being open, it is female during the first opening and male during the second opening. The physiological regulation is seen first in the development of the two sexes in each flower at different times (dichogamy) and second in the coördination of this development among entire sets of flowers so that the dichogamy is synchronous for the tree as a whole.

THE TWO TYPES OF DAILY SEQUENCE IN THE ALTERNATION OF SEXES

A general survey of many seedlings and many named clonal varieties of avocados, including Guatemalan, Mexican, and West Indian types and hybrids between these, growing in California and in Florida, indicates that they may all be grouped into two main classes with respect to the daily changes of sex in the flowers. About half of them behave similarly to the trees of the Taylor variety described above and these may be grouped together and designated as Class *A*. In the other group of seedlings and varieties (Class *B*) the sequence in the daily alternation of two sets of flowers is the *reverse* of that of Class *A*. For these the second-period or male opening of sets of flowers is, normally, in the forenoon, and their first-period or female opening is in the afternoon.

The relative flower behavior of the two groups may be shown by comparing flowers of two varieties such as Taylor and Panchoy.

In the forenoon, while flowers of Taylor are in the first period or female anthesis, the flowers of Panchoy are all of the second-period or male opening (upper photo of PLATE 26). Trees of Panchoy are shedding pollen during the forenoon while the flowers of trees of Taylor are most ready to be pollinated. During midday an alternation or change in sets occurs for each and then *in the afternoon* the flowers open on Panchoy are in the first period or female opening while the flowers open on Taylor are all of the second period or male opening (see lower photo of PLATE 26). These two varieties are, therefore, reciprocating in their daily alternations of sex. Taylor is female while Panchoy is male and then while Taylor is male Panchoy is female—all during the hours of a single day.

Extending the observation to trees of other varieties growing side by side one finds that the daily behavior of flowers is either like that of Taylor or similar to that of Panchoy. This is readily revealed when the daily sequence in the flower behavior of a number of varieties (all clonal varieties) is shown diagramatically as in CHART 1. The observations there recorded are for trees growing in the same orchard or in a nearby one and are all for the same day, which was one of a series of warm sunny days on which the flower behavior may be considered as most nearly normal.

It may be stated that in obtaining such records as are shown in the various charts accompanying this report observations were made from tree to tree as quickly as possible, especially during the midday shift of sets. These were checked on squared paper for fifteen-minute intervals. If, for example, flowers were not open on a tree at 8:05 but were open rather abundantly at a next visit at 8:25 the start of opening was credited to 8:15. If at 12:20 first-period flowers were rapidly closing and at 12:40 they were all closed the time of closing was checked for 12:30. Thus in the charts there is rarely an error of 15 minutes, and for the majority of cases the start of opening and the end of closing of sets is given within five minutes of the correct time.

This record (see explanation of chart for symbols used) is typical of that which may be obtained day after day during favorable weather (see also CHARTS 2, 3, and 4). Such records reveal the general rules of the normal flower-behavior during the hours between sunrise and sunset in a single day.

1. For all varieties there are two different sets of flowers open during the day. The flowers of one set function as females, those of the other as males. Each set opens and closes in unison and the two sets are open during different hours of the day. While there is frequently a short interval of overlap of the two sets during the shift in midday, the rule is that no pollen is shed while flowers in the female condition are open. Pollen is lacking for a time after flowers open for the second period and then it is scant for a time. Later the maximum of pollen shedding is reached after which pollen again becomes increasingly scarce. Unless pollen is carried away by insects the masses of pollen harden and become dried into little balls that fall to the ground. It seems most probable that the pistils are not fully receptive for fertilization during the entire time flowers are open for the first period and that a line representing their most receptive condition would be much shorter than is shown in the various charts. But considering the entire periods of opening, in every case the synchronous alternation of sex most decidedly limits self- and close-pollination.

2. The varieties fall into two groups which reciprocate with respect to the relative sequence of the daily alternation in the development of the two sexes. The members of one group are female in the forenoon and male in the afternoon while the members of the other group are male in the forenoon and female in the afternoon.

List of the most important varieties according to the daily sequence of dianthesis

A. Varieties that normally have flowers open for the first or female opening in the forenoon and flowers open for the second or male opening in the afternoon:

Atlixco
Baker
Baldwin
Benik
Butler
Cantel
California
Trapp
Challenge
Clower
Colorado
Dickinson
Dickey
El Presidente
Family
Gottfried

Grande
Hawaii
Kanan
Kashlan
Lulu
Manik
Mayapan
Murrietta Green
Murrietta 2 lb.
Perfecto
Pinelli
Popenoe No. 3
Puebla
Richardson
Sharpless
Simmonds
Sinaloa
Solano
Spinks
Taft
Taylor
Ultimate
Wagner
Waldin
Wester

B. Varieties that normally have flowers open for the second or male opening in the forenoon and flowers open for the first or female opening in the afternoon:

Akbal
Butternut
Cabnal
Cardinal
Champion
Colla
Collins
Cook
Dorothea
Eagle Rock
Earle's Late
El Oro
Estelle
Fuerte
Fulford
Ganter
Golden, Taft's
Hanson
Hardee
Harmon
Ishim
Itzamna
Knight
Lamat
Linda
Lyon
Mattair
McClure
McDonald
Meserve
Montezuma
Nabal
Nimlioh
Nimliohson
Northrup
Nutmeg
Panchoy
Pollock
Queen
Rey
Rolfs (old)
San Sebastian
Schmidt
Stephen's Choice
Surprise
Tertoh
Trapp
Tucker
Tumin
Verde
Walker
Winslow
Winslowson

One or more trees of each of the above-named varieties have been observed in flower by the writer either in California or in Florida. For most varieties observations of normal flower behavior were made for a number of trees and on a number of days. In a few cases the tree or trees studied may have come to the grower wrongly named or the identity may otherwise have been given incorrectly. A tree called El Oro studied in California was *A* in behavior and a tree of this name in Mr. Krome's orchard in Florida was *B*. A tree studied in California under the name Ishkal was *B* in flower behavior; one of this name observed by Mr. T. Ralph Robinson (reported to the writer by letter) at Lucerne Park, Florida, was *A* in flower behavior. The normal daily sequence of sets of flowers is, of course, the same for all trees of any of the clonal varieties of the avocados whether grown in California or in Florida.

The number of varieties having the *A* behavior is nearly equal to the number having *B* behavior. There is no definite evidence regarding the heredity of flower behavior further than the fact that the two main classes *A* and *B* seem to exist in nearly equal numbers.

THE CYCLES OF DIANTHESIS OF THE SETS OF FLOWERS

The entire time from the first opening to the final closing of a flower or of sets of flowers, which includes the two periods of opening and the interval of closing between them, may be called the complete cycle of dianthesis, the flowering cycle, or merely "the cycle" of a flower or of a set of flowers.

The striking difference in the *daily* behavior of the flowers of the two main classes of avocados is that the sequence of the two sets is reversed. This involves and is accomplished by decided differences in the flowering cycle of the sets of flowers with reference to the time of the day when the two periods of anthesis occur and in respect to the length and the time of the interval during which the flowers are closed between the two separate openings. This is revealed by "tagging" some of the flowers and tracing their behavior throughout the following day. This method was used very generally throughout the investigations both in California and in Florida.

The main types of flowering cycles thus revealed for sets of flowers may be shown by the diagrams in CHART 5.

For the *A* varieties (of which Taylor, described above, is typical) daily a set of flowers opens for the first or female opening in the forenoon and then closes about noon to remain closed for 24 hours (until the following afternoon) before opening for the second or male opening. The cycle of a set covers about 36 hours. During the hours of sunlight each day two different sets of flowers are in action. During the hours of darkness one set is in the interval between the two openings (see A in CHART 5).

For all *B* varieties, in normal behavior, daily a set of flowers opens for the first or female opening in the afternoon and closes late in the afternoon. But in respect to the further history of the sets, there is a decided diversity.

For certain *B* varieties the rule is for each set to open for the second time during the next forenoon after an interval of about 12 hours. For such sets the complete cycle is about 24 hours. In this case but *one* set is in some stage of the cycle at a time (see B1 in CHART 5) and it completes its flowering cycle alone and while every other set is inactive. The studies indicate that this behavior is characteristic of certain West Indian varieties of which Trapp may be mentioned as fairly typical. In Florida in 1925 the weather during February and March was unusually warm and the 24-hour cycle was usual for sets of flowers on many of the *B* varieties.

For certain of the *B* varieties, however, sets of flowers opening for the first time in the afternoon may remain closed for two nights and one day (of daylight). The interval between the two openings is 36 hours and the entire cycle covers 48 hours as shown in B 2 of CHART 5. Under such behavior three different sets of flowers, including the set in the interval, are in some stage of action during each period of daylight. During the hours of darkness two different sets are in the interval. In California, throughout nearly all of the period of study in 1923, this was the regular rule of sequence for *B* varieties under observation when there was a normal daily alternation. The nights were, however, much cooler than in Florida. Nothing like the Florida conditions of March 1925 were experienced in California in 1923 where studies were made, until very late in May when the blooming of avocados was mostly over.

On trees of certain varieties the cycle of sets of flowers may shift from 48 to 24 hours, or *vice versa* in response to certain changes in weather. It is to be noted, however, that at times when the 48-hour schedule gives normal daily alternation of two sets for these varieties, certain other varieties of the *B* group, such as Trapp, may be blooming on the 24-hour schedule. None of the tender West Indian varieties which in Florida rather persistently bloom on the 24-hour cycle were available to the writer for study in California.

It was frequently observed, especially of the Harmon and Fuerte varieties, that a single set of flowers opening and closing in unison for the first period will divide into two groups; part of the flowers will open to shed pollen the next forenoon (interval of 12 hours) and the others will remain closed for an interval of 36 hours (see B 3 in CHART 5). Then, on any given forenoon, part of the flowers of two different sets shed pollen. Those of the older set (of 36-hour interval) begin shedding pollen somewhat the earlier. The three types of behavior (B 1, B 2, and B 3) may all be observed in a single day for different varieties growing side by side in the same grove.

In considering the sequence of complete cycles of sets of flowers, the varieties of the *B* group show the greatest diversity. The simplest sequence seen among avocados is that with the 24-hour cycle and the 12-hour interval (see B 1) and the most complex is in the splitting of single sets into groups having 24-hour and 48-hour cycles.

It would seem that marked changes in the cycles of sets such as are described above must have a profound influence on the ability of flowers to function in fruit-setting entirely independently of pollination.

No attempt is here made to indicate cycles of anthesis during periods when off stride and irregular blooming breaks the normal daily alternation and its regular sequence.

INDIVIDUAL OF VARIETAL DIFFERENCES IN FLOWER BEHAVIOR

The various charts recording normal daily alternation of sets (CHARTS 1–4) reveal that noticeable variations exist among different varieties of each group *A* and *B* regarding the particular hours in the day when the sets of flowers are open.

Thus, for the *A* varieties studied on February 24 (CHART 1), there was a difference of two hours in the time when the different sets of first-period flowers began to open. The length of time these sets were open also varied; for Atlixco the time was from 9:00 A. M. to 2:00 P. M., while for Pinelli the period was from 11:00 A. M. to 2:15 P. M., a difference of nearly two hours.

Even more marked differences are seen for the sets of first-period flowers among varieties of the *B* group. For some varieties, such as Queen and Meserve, the first-period flowers begin to open early in the afternoon, for others this set starts to open late in the afternoon.

Similar differences exist in the performance of sets open for the second period. As a rule the periods for the two sets normally opening on any one day are closely coördinated in sequence, especially for *A* varieties. But in the *B* varieties the sets of second-period flowers are rather uniform throughout as to their hours of shedding pollen, while marked differences exist as to the sets of firsts. Thus, for example, the seconds on Meserve and Trapp (CHART 1) act quite alike but their sets of firsts for the same day behave very different as to time of opening.

Thus, for some varieties and particularly the *A* varieties, there is normally a short *period of overlap* or a time when one set is closing and another set is opening. A period of overlap (for a reverse order of sequence) exists for some of the *B* varieties but for several of these, Pollock, Hardee, Trapp, Estelle, and Taft's Golden, there is normally no overlap but a decided *lapse between openings.* After the set of seconds which is open in the forenoon is fully closed, there is a period of as long as three hours before the day's set of firsts starts to open during which no flowers are open. Nirody (1922) observed and reported this condition for the varieties Fuerte, Linda, Pollock, Queen, Trapp, and McDonald, and for all but the last named he noted that the flowers which open late in the afternoon are from "fresh buds" and that they close for the night without shedding pollen. Evidently Nirody considered that this was merely a closing for the night, which in these varieties is indeed the case. In none of the *A* varieties did he discover the closing of sets of first-period flowers at midday and he considered that for these the same flowers were open throughout the day for only one continuous opening.

In the various charts (1 to 4) the records are arranged with the varieties listed in order according to the time when the first-period flowers start to open. This arrangement brings out the differences that exist among varieties as to the precise time in the same day when the two sets are open, and as to the extent and the particular time of the period of overlap and of the period of lapse between sets.

A comparison of the charts for different days shows clearly that these relative differences are rather constant characteristics of varieties. The varieties standing first or last in the two groups of *A* and *B* remain thus day after day with decided uniformity.

IRREGULAR AND ABNORMAL FLOWER-BEHAVIOR

The particular behavior of sets of avocado flowers, as to precise time of opening, duration of the opening, period of overlap and lapse between sets, is affected by weather conditions and particularly by changes in temperature. In extreme cases the entire sequence of normal behavior is thrown entirely out of stride and the action of the flowers becomes very irregular.

When the temperatures tend to be low the hours of opening are comparatively late in the day (CHART 3). With higher day and night temperatures and with increasing hours of daylight the hours are earlier (see CHART 4). Thus the "clock" hours for opening tend to be later during the earlier part of the season of bloom (January and February) and earlier in the day during April and May. This general trend to earlier hours is shown when the daily performance of a single variety is charted for an entire season of bloom (see CHART 9).

A change to a lower temperature at night will frequently result in the differences recorded in CHARTS 3 and 4. Here the relative behavior of the two sets of flowers for each variety, the relative behavior for different varieties as such, and the relative performance of the *A* and of most of the *B* groups remain quite uniform. The hours of opening for all merely shift to later clock hours.

With an increasing severity of changes in temperature, flower behavior becomes correspondingly more abnormal until the daily sequence of sets is thrown out of stride and the flowers belonging to one or more sets respond with marked irregularity.

Even under slight lowering of temperatures, for such varieties as Trapp and Taft's Golden, the first or female opening may be omitted by an entire set or a part of a set (see in CHART 3). Such flowers really open but once. They may then shed no pollen at all, they may shed pollen poorly, or they may shed pollen freely and quite fully, depending on conditions of weather.

The first anthesis of sets of flowers may be delayed from forenoon to afternoon (in *A* varieties) and from afternoon to the following forenoon (in *B* varieties) and the second opening of the sets following may be correspondingly delayed. On days when this occurs there will be a very general and complete reversal in the *daily* alternation normal to the varieties (see record for May 17 in CHART 8). Flowers in the first period of opening may be held in this condition for some time, even continuing thus over night from one day to another.

Sets of flowers subjected to sudden lower temperatures while in the interval exhibit irregular behavior in the second opening. This may be delayed, prolonged, or even omitted. The various flowers of a single set may behave quite differently.

A decided change from a period of cold inclement weather, during which there was much delay in the opening of sets of flowers, to warmer weather favorable to normal flower-behavior sometimes brings three different sets of flowers into opening between sunrise and sunset (see record for May 19 in CHART 8).

In response to decided changes in temperature the blooming of all varieties is thrown off-stride and marked irregularities appear in nearly every aspect of flower behavior. The records of CHARTS 6 and 7 (see explanation with charts) are fairly typical of such behavior.

Comparing the season of bloom of 1925 in Florida with that of 1923 in California for the orchards in which the writer made observations, it can be said that in California there were many more days of irregular behavior.

Varieties differ in the degree and the type of irregularity which they exhibit. The observations both in California and Florida indicate that the varieties of the *B* class exhibit the greatest irregularity and off-stride behavior under unfavorable weather conditions. Weather which merely delays the opening of the two sets on varieties of the *A* group will often cause various varieties of the *B* group to continue a set of firsts open over night and into the next day, or to skip a set of firsts, or to have them open for a period during the night. See especially the records here given for March 4 and 5 in CHART 6.

Frequently during irregular and off-stride blooming there is an overlapping of different sets and first-period flowers may be open at the time second-period flowers are shedding pollen.

There is then an opportunity for close-pollination. When a set of flowers skips the first period and has a single opening during which pollen is shed, there would seem to be opportunity for self-fertilization of individual flowers provided the pistils have remained receptive to the pollen. There is, however, some question as to what extent off-stride flowers can function in fertilization and fruit-setting.

The variations in blooming due to influences of weather and the time of the season no doubt have an effect on pollination relations and on the efficiency of pollinations in the setting of fruit. Growers frequently state that often the fruit borne by avocados is set late in the period of bloom.

THE REGULATION OF THE FLOWER MECHANISM

It seems evident that the principal external stimuli affecting the flower mechanism of avocados are light and temperature. The rule is that during normal action the flowers are open only during the hours of daylight. Changes in temperature, however, produce marked irregularities in the action of the flowers irrespective of light.

The influence of low temperatures was tested by submitting branches with flowers to the cool temperatures of an ice-box. Under such treatment flowers that were fully open remained thus for hours after flowers of the same set left on the trees had closed. Meanwhile flowers in the interval between the two openings remained closed while those of the same set left on the tree opened normally. Low temperatures seem to inhibit changes in flowers as may be expected from the observations on off-stride and irregular behavior.

Clusters of flowers were placed in an ice-box during the midday shift of sets when first-period flowers were in process of closing and when second-period flowers were about halfway open. In several instances the action of these two sets was stopped and reversed. The first-period flowers returned to the condition of being widely open and the second-period flowers returned to the fully closed condition. An extension of such studies would no doubt reveal much regarding the influence of temperature on the flower mechanism and the time relations of the reactions.

It would appear from observing the action of the flowers that the movements of the parts involve chiefly changes in turgor with perhaps some actual growth of certain parts. The coördinated action of sets of flowers does not necessarily imply that there is a regulation by internal stimuli. It may only involve an identity in the constitution and condition of the many flowers which mature in each set. But in the repeated synchronous maturity of sets there would seem to be a very fundamental coördination in the growth and development of flowers throughout the entire plant.

Each flower normally exhibits two different actions. The mechanism of the first opening and the mechanism of the second opening operate under different external stimuli. The same stamens which reflex strongly in the first anthesis stand nearly erect in the second anthesis, but in the interval between they grow noticeably. The same segments of the perianth open and close in quite the same manner in both openings but they reflex more strongly and for most varieties close more tightly in the first opening. The pistil evidently usually matures during the period of the first opening, which is when the inner set of nectaries excrete nectar. The outer set of nectaries functions at the time pollen is shed. The two sets of nectaries are, however, quite different in appearance. Those of the inner set resemble aborted stamens; those of the outer set are shorter and more rounded and dome-shaped.

In both groups of varieties (*A* and *B*), the flowers are apparently identical in general morphology and in the mechanism of each of the two openings. Yet the conditions of light, temperature, and humidity of the forenoon or of the preceding hours bring into simultaneous opening first-period flowers on *A* varieties and second-period flowers on *B* varieties and the midday brings a shift of sets in each in the reverse order. Such decided and specific differences in action can only be due to differences in the inherent constitution of the two groups of varieties.

EVIDENCE BEARING ON THE EVOLUTION OF DIANTHESIS AND SYNCHRONOUS DICHOGAMY IN AVOCADOS

The flower behavior of avocados exhibits an advance in development beyond the dichogamy generally seen in other plants in at least three important particulars.

First there is a definite and pronounced interval between two distinct openings of each flower. Except for general periodic closing such as night closings, the dichogamous flowers of other species (as far as known) have one continuous period of opening and the flowers have what amounts to a single opening.

This is closely approached or perhaps realized in certain of the *B* varieties which have the shortest cycle in the action of sets of flowers (see CHART 5) and in which the interval of closing is for one night only. From this rather simple and short cycle the complexity increases to cycles having longer intervals, giving flowering cycles of 36 hours and 48 hours.

Furthermore, certain changes in temperature may cause flowers or sets of flowers to skip the first opening and to open only for a single opening. And the varieties with the shortest interval are most liable to behave thus. All this may be taken as evidence that the extended cycle of the avocado flower with its two periods of opening has evolved from a simpler cycle of only one anthesis. A study of flower behavior in the close relatives of the avocados may reveal evidence on this matter.

So far as is known, in other plants dichogamy is not exclusively synchronous for the entire plant. For certain species having monoecious flowers, there is a tendency for female flowers to ripen before the male flowers, giving somewhat of a seasonal alternation in the sex of the entire plant. In pecans, for example (see Bulletin No. 124, Georgia Experiment Station, by H. P. Stuckey) this condition is so fully developed for certain clonal varieties that they are decidedly self-fruitless. But for plants with perfect but dichogamous flowers the rule is that some flowers will be shedding pollen while others are ready for pollination. Unless there be but one flower open at a time there is chance for close-pollination. For avocados this condition is frequently seen when there is overlap of sets during off-stride and irregular behavior. The ease with which this occurs may indicate that this was the general condition from which evolved the perfection in the daily and synchronous alternation of sexes now seen in avocados.

In avocados the climax in the adaptation of dichogamy for cross-pollination is seen in the reciprocation of the daily sequence. Nothing approaching this condition is known for any other group of plants. There are two classes of individuals, apparently nearly equal in number, and the daily sequence of one is the reverse of the other. This indicates an inherent organization with hereditary values and determination.

But the precise behavior is far from uniform among the individuals of either group. In respect to time of the opening of flowers, the duration of the periods of opening, the length of the interval and the period of overlap, there are wide differences characteristic of individual seedlings and clonal varieties.

When the behavior of varieties is arranged in sequence for the time of first opening there are many gradations from the earliest of the *A* varieties to the latest of the *B* varieties (see CHARTS 1 to 4). The hereditary basis involved in the differentiation of the two groups can scarcely be considered as due to a few simple units of uniform value and as achieved in one step by a single change in heredity.

THE MALE STERILITY OF THE COLLINSON VARIETY[1]

The Collinson variety is an exception among cultivated varieties of avocados in that it is completely sterile as a pollen parent. The flowers have two periods of opening and the second opening is normally in the afternoon but the anthers remain closed and no pollen is shed (see in PLATE 27). Sections properly prepared for microscopic study reveal that the stamens are mere masses of sterile tissue.

The writer has made observations on the flowers of the original tree of the Collinson (a seedling from open-pollinated fruit collected at the Miami Station for Plant Introduction), of some of the first trees propagated from its buds, and on about thirty Collinson trees of blooming age in grove plantings. For some of these trees observations were continued day after day over a period of more than two weeks. In two instances a single anther valve was found lifted but no pollen was present.

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[1] The writer did not see any trees of this variety in California.' The facts regarding the male sterility of Collinson were first determined in 1925 through the joint observations of Mr. E. M. Savage and the writer.

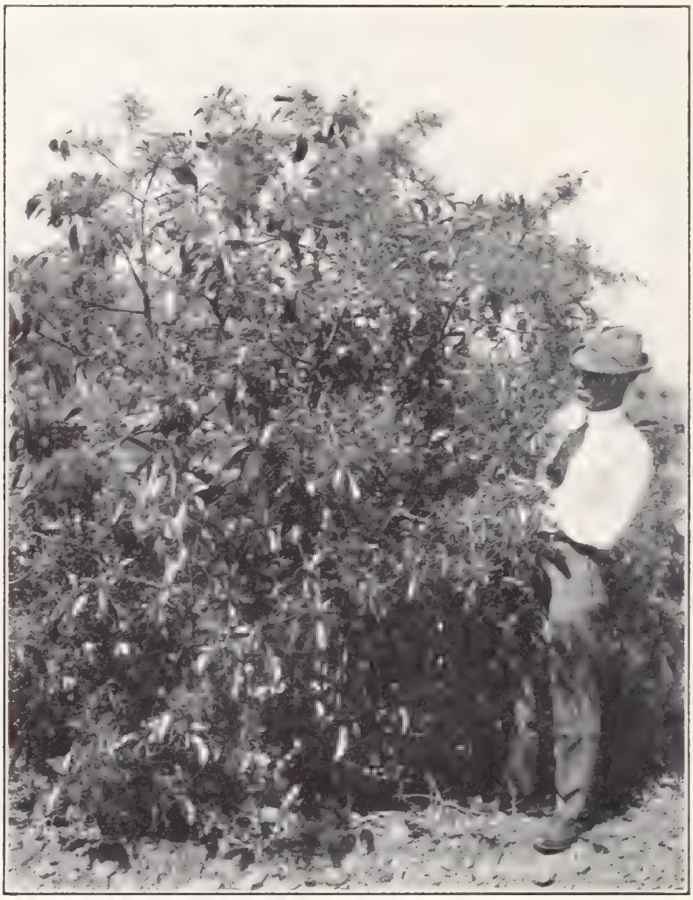
Trees of the Collinson variety appear to be completely impotent as pollen parents. Their flowers shed no pollen. The fruits maturing on them are all the results of cross-pollination unless they develop without any pollination.

THE RESULTS OF POLLINATIONS MADE BY HAND

Fruit is not readily obtained on avocados even by the most careful pollinations made by hand.

In California several thousand self- and close-pollinations were made by hand and in Florida several hundred were made. The self-pollinations were necessarily for flowers shedding pollen either in their second period of opening or when the first period had been skipped. The close-pollinations were, of course, made at times when there was an overlap of first-period and second-period flowers on the same tree. These are precisely the kind of pollinations possible when a tree is grown in isolation, or is tented, or when a solid block of one variety is grown. Not one of the flowers thus pollinated set a fruit.

But relatively few cross-pollinations succeed. In making such pollinations flowers which were in the height of shedding pollen were taken from one variety and their pollen applied directly by rubbing the pollen masses over the stigmas of flowers of another variety open for the first time. These are the pollinations which flower behavior indicates are most likely to be most proper. With the assistance of various students of Pomona College and particularly of Mr. Howard Lorbeer, the writer made 3,430 such pollinations in California. These involved chiefly the varieties Dickinson, Puebla, and Taft of the *A* varieties and Fuerte, Harmon, and Northrop of the *B* varieties. In February 500 of these pollinations were made, in March 1,280, in April 885 and in May 765. Most of them were made while there was much delayed action in flower behavior and while very little fruit was setting



EXPLANATION OF TEXT FIGURE 1

Many varieties of avocados bloom so profusely that a small tree, such as of the Dickinson variety here shown, will produce many thousands of flowers. Day after day sets of flowers come into bloom. It is a physical impossibility for the tree to hold and mature fruits for even one per cent. of all the flowers. But for most varieties few fruits set even where insects may visit the flowers abundantly. One may make careful cross-pollinations only to have most of the flowers fall promptly. Possibly many of the flowers, especially when in off-stride or irregular action, are unable to yield fruits to any sort of pollination. In the end there may be few or even no fruits on the tree.

From the flower behavior of avocados it is clear that there is a decided adaptation for reciprocal cross-pollination between certain varieties. An increase in proper cross-pollination is liable to give increased yields of fruit.

in the orchards. On June 8th at the last census which the writer was able to make, a total of 173 fruits were setting and some of them were nearly an inch in diameter. A heavy wind storm during the summer stripped most of the fruit from the orchard of Mr. Thomas Sheddon in which many of the fruits were. The pollinations were chiefly made in six rather widely separated orchards and the writer was unable to secure data as to the number of fruits that did mature. On June 8th fruit was developing to 5 per cent. of the flowers cross-pollinated.

The results of the hand pollinations clearly indicate that the relations of pollination to fruit setting are not readily to be determined for avocados by hand pollinations as they may be for many other types of plants. The percentages of sets thus far obtained by this method are too low to be of much significance. Either the pistils, or pollen, or both can not be used with success except during a particular and perhaps very limited period, or the pollinations are not made in the way necessary to success, or it may be *that a large majority of the flowers produced are not able to set and mature fruit to any kind of pollination!*

FRUIT-SETTING BY TENTED TREES WITH BEES ENCLOSED

The extent to which avocado trees are able to produce fruit without cross-pollination may, it would seem, be determined by enclosing an entire tree in a cheesecloth house or tent during the entire period of flowering and supplying a hive of bees to make the pollinations. This was done during the season of 1925 in the orchard of Mr. W. J. Krome at Homestead, Florida. The data on the fruit setting were secured by Mr. Savage after the writer had left Florida.

A tree of each of the varieties Linda, Panchoy, Taft, and Trapp were tented. The selection of these particular varieties was fortunate in that it allowed tests for several different types of flower behavior.

On May 29th, about eight weeks after the close of the blooming season the Taft tree which had been tented had seven fruits. Two other Taft trees of about the same size standing close by and subjected to open orchard pollination bore 44 and 68 fruits

EXPLANATION OF TEXT FIGURE 2

In the tenting experiments entire trees were enclosed in a cheesecloth tent throughout the period of bloom. The strips of cheesecloth were overlapped and nailed under laths to a frame so insects could neither leave the tent nor enter from without. A hive of bees was placed within each tent. The bees worked among the flowers most industriously on most days throughout the entire period of flowering. Under the forced insect pollination each of the four trees tented did mature some fruit. The largest number of fruits for any tree was 22. The results indicate that trees of these varieties are not able to yield full crops to self-pollination only.

respectively. The Panchoy tree which had been tented bore two fruits, while the one other tree of this variety in the same grove bore 12 fruits. The tented tree of Linda had 22 fruits while nine other trees of this variety no larger than the tented tree subjected to open orchard pollination had fruit as follows: 23, 30, 41, 55, 56, 62, 64, 88, and 138. The tree of the Trapp variety bore 18 fruits. On nine other trees of this variety, quite similar in size and standing in the vicinity of the tented tree, there were fruit as follows: 3, 6, 7, 8, 12, 12, 23, 24, and 64.

Each of the tented trees did set some fruit. The yields were low for Panchoy and Taft. The tented tree of Trapp seemed to do as well as about half of the trees of the variety around it. The highest yield on a tented tree, 22 for the Linda, was decidedly lower than that of other trees of this variety.

It should be noted that the tented trees received a highly forced pollination. Day after day the bees worked most industriously among the flowers. On most days every flower was probably visited many times. Obviously flowers in the second opening had pollen liberally distributed over the pistils as soon as pollen was shed. Whenever there was an overlap the pistils of flowers in the first opening had an excellent chance to be close-pollinated not once as in hand pollinations, but many times. For Linda and Panchoy second-period flowers normally shed pollen in the forenoon and possibly bees may have carried pollen on their bodies from late forenoon until the time in the afternoon when first-period flowers were open. For the Taft there would be no such chance as this but only direct and almost immediate self-pollination of second-period flowers or of close-pollination when there was overlap, which the season's record (CHART 9) shows rarely occurred in 1925.

For the Trapp with its first-period flowers opening late in the afternoon (see CHARTS 3, 4, and 10) it would seem that the best chance for fruit-setting when tented would be to self-pollination of flowers that had opened late on the afternoon of the previous day or had skipped this period of opening as is frequent for the variety.

It would seem also from flower behavior that there is very little opportunity for the first-period flowers of Trapp to be cross-pollinated. They open so late that there is scarcely any pollen available from *A* varieties. On account of this the chances for fruit-setting in the Trapp may be fully as good for a tented tree as for trees in the orchard, or even much better when the tented tree is given a hive of bees.

On the basis of flower behavior one might predict that the flowers of Taft with their 36-hour cycle (*A* in CHART 5) and scarcely any overlap (see CHART 9) would set very few fruits without cross-pollination and also that Trapp with a short cycle and frequent skipping of the first opening would be most liable to set fruit to self-pollination accomplished during the second period of flower opening.

There is no question that the flowers of the tented trees received bee visitations far in excess of what flowers of any orchard tree is likely ever to receive. If trees of these varieties readily set fruit without cross-pollination, the tented trees should have borne heavy crops.

Here the comparisons of yields are between tented trees with abundant and almost complete enforced self- and close-pollination and trees submitted to open pollination. Honey bees were not kept in the vicinity of Mr. Krome's orchard and they were rarely seen in it. The orchard pollination was accomplished by wild insects and chiefly, it would appear, by certain flies and wasps. Proper cross-pollination between *A* and *B* varieties may have been frequent or scant. For an adequate comparison, the results obtained for tented trees should be checked against those obtained when there is repeated and abundant cross-pollination between varieties reciprocating in flower behavior. No such data were obtained and such data would be difficult to obtain. Even when two trees of different and reciprocating varieties are enclosed in one tent, *individual bees* may not freely make the cross-visitations necessary to proper pollination. Further matters concerning the relations of insects to pollination of avocados has been discussed in considerable detail elsewhere (Stout, 1924 c, and 1925).

Some results of tenting experiments with avocados conducted at Point Loma, California (Clark, 1923, 1924), indicate that under certain conditions some varieties may set considerable fruit or perhaps yield good crops to enforced self- and close-pollination by bees. The daily sequence of blooming reported for Point Loma by Clark as "usual" for Fuerte and Spinks is the irregular and off-stride and exactly the reverse of the normal for these varieties. Possibly at the Point Loma location proximity to the ocean may very generally give an off-stride blooming that may somewhat favor fruit-setting to self- and close-pollination.

A few varieties of avocados will frequently set fruits for nearly every flower. They will do this when the flowers are enclosed in a paper bag so that all cross-pollination is impossible and all insects visitations are prevented. As many of these fruits apparently contain no embryos, they evidently set without pollination and fertilization. Usually these fruits soon fall. In some varieties, however, seedless fruits frequently develop to maturity on the trees. It seems highly probable that when fruits do set in abundance many start to develop without proper pollination and that the fruits that do remain to maturity and develop to proper size are those whose embryos are the products of most proper pollination and fertilization.

There is little direct evidence, experimental or otherwise, as to the exact kind of pollination which is responsible for the fruit that does mature on avocado trees. There is a long period of bloom with a large number of flowers open day after day. A very low percentage of the flowers mature fruit or in most cases even set fruit. The percentage still remains low when one makes most careful hand pollinations, so this method has thus far given no very conclusive data. Possibly, when flowers are fully functional and insects are working most effectively, a few insects make all the pollinations responsible for a full crop in a few minutes, but what these conditions are and when they occur remain to be determined. It is most probable that these conditions are different for different varieties.

Remarks on the interplanting of avocados

It is obvious that the flower behavior of avocados greatly limits the chances for proper self- and close-pollination. If a tree stands alone with no tree of *another* and *reciprocating* variety within insect range, there is little chance that many of the flowers will be pollinated at the proper time.

As avocados are propagated vegetatively, the varieties are all clonal varieties. The many trees of the variety are merely branches derived from one original seedling and when standing together they daily exhibit the same action of flowers. There is no question but that the proper interplanting of different varieties of avocados on the basis of their relative flower-behavior will greatly increase the chances for proper pollination and thereby make possible more abundant and more uniform yields of fruit.

It has been noted that certain avocado trees grown in apparent isolation may yield fair crops of fruit. But it is also well known that many such trees have borne few or even no fruits year after year when all conditions, except opportunity for cross-pollination, were highly favorable to fruit production. Varieties like Harmon, Taft, and Fuerte have very generally been shy bearers when grown alone or in solid blocks. Yet the Trapp is one variety that has the reputation of being a rather consistent bearer. Differences among varieties in ability to produce fruit to pollination within the variety are to be expected from the marked differences seen in flower behavior. Local conditions of weather may decidedly affect fruit-setting through influencing flower behavior and this may vary considerably in different years. But the general experience has been that for most varieties yields of fruit are frequently low whenever trees of one variety are planted in solid blocks.

The sole aim in interplanting avocados is to increase the yields of fruit beyond that obtained or possible in solid block plantings of single varieties. It can do this only to the extent that it corrects faulty or inadequate pollination and to accomplish this at least three conditions must be satisfied.[3]

1. The interplanting must provide opportunity for an increase in the number of proper pollinations that are possible. This opportunity is provided for when trees that are normally female in the morning are interplanted with trees that are male in the forenoon, provided, of course, that they bloom together for a considerable span of calendar dates. A further selection may be necessary in those cases in which the daily periods are characteristically early or late (see CHARTS 1–4).

2. Means for effecting pollination must be provided and must be in operation year after year. Insects are without doubt the natural agents for the pollination of avocados. Honey bees are fond of avocado nectar, they freely visit the flowers during both periods of their opening, and when their hives are in the vicinity of avocado trees they are frequently seen in great numbers working among avocado flowers. But for an insect to effect cross-pollination it must repeatedly fly back and forth from one variety whose flowers are shedding pollen to another whose

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[3] A more complete discussion of interplanting has previously been printed (Stout, 1925) and also reprinted in a later paper (Stout and Savage, 1925). This matter will therefore only be briefly summarized here.

flowers are in the first or female opening. Observations indicate that individual honey bees may not do this freely.

3. The pollinations when made must result in fertilization if there is to be setting of fruit. There seems to be some evidence from field plantings which suggests that certain varieties cross-fertilize more readily than others but whether this involves merely increased cross-pollinations or affinities in fertilization is not now known.

At the present time there is no rule of thumb for the interplanting of avocados that will insure unqualified success. On the basis of flower behavior alone, the orchardist makes no mistake to interplant every variety and to choose one or more pairs for the interplanting whose reciprocating flower behavior provides chances for abundant cross-pollination.

Any interplanting on this basis is better than none at all. The grower may not immediately hit upon the best combination which (1) provides the best opportunity for abundant cross-pollination, (2) encourages and facilitates cross-visitations by insects, and (3) involves strong affinities in fertilization, but he will be no worse off than if solid blocks are planted and he stands a good chance to increase fruit production.

It is to be emphasized that interplanting aims only to correct fruitlessness that is due to faulty or inadequate pollination. The many environmental and cultural conditions that affect or determine production of fruit must be met. They exist quite apart from, independently of, and in addition to the problems of proper pollination and they very frequently limit production of fruit when all the conditions for proper pollination are fully satisfied.

While environmental conditions and cultural treatment greatly influence the holding and the maturing of fruit, the setting of fruits most likely to mature depends without a doubt on proper pollination. That an increase in proper pollinations is to be accomplished through cross-pollination is obvious. That this is to be promoted through proper interplanting with consideration of flower behavior is also fully obvious.

Acknowledgment

This is a report of investigations which the writer made in California in 1923 and in Florida in 1925. The studies in California were made under the auspices of Pomona College and in coöperation with the officers and various members of the California Avocado Association. Those in Florida were conducted under the auspices and with the financial support of The New York Botanical Garden and the Farm Bureau of Dade County, Florida. This coöperation was accomplished chiefly through the keen interest of Mr. T. Ralph Robinson of the Bureau of Plant Industry, of Mr. Wm. J. Krome, of Homestead, Florida, in whose orchards most of the studies were made, and of Mr. J. S. Rainey, County Agent of Dade County. During most of the period of study in Florida Mr. E. M. Savage of the Bureau of Plant Industry participated in the investigations as did also Mr. T. Ralph Robinson for a part of the time. The writer is pleased to acknowledge the assistance and coöperation rendered by all these persons and also by other officers and members of the Florida and the California Avocado associations not here mentioned by name.

In this report the aim is to present in one paper the most important facts thus far determined regarding flower behavior in avocados, together with more ample illustration by photographs and charts than has hitherto been possible. While this report includes many new data obtained in Florida for varieties not available in California, there is necessarily some repetition from papers previously published. But for the most part these papers are in publications not readily available in botanical libraries.

LITERATURE BEARING ON FLOWER BEHAVIOR OF AVOCADOS

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Note. After this volume of the Memoirs of The New York Botanical Garden was fully paged by the printers, a publication "Pollination of the Avocado," Department Circular 387 of the U. S. Department of Agriculture, by T. Ralph Robinson and E. M. Savage, was received (October 26, 1926.)—A. B. STOUT.

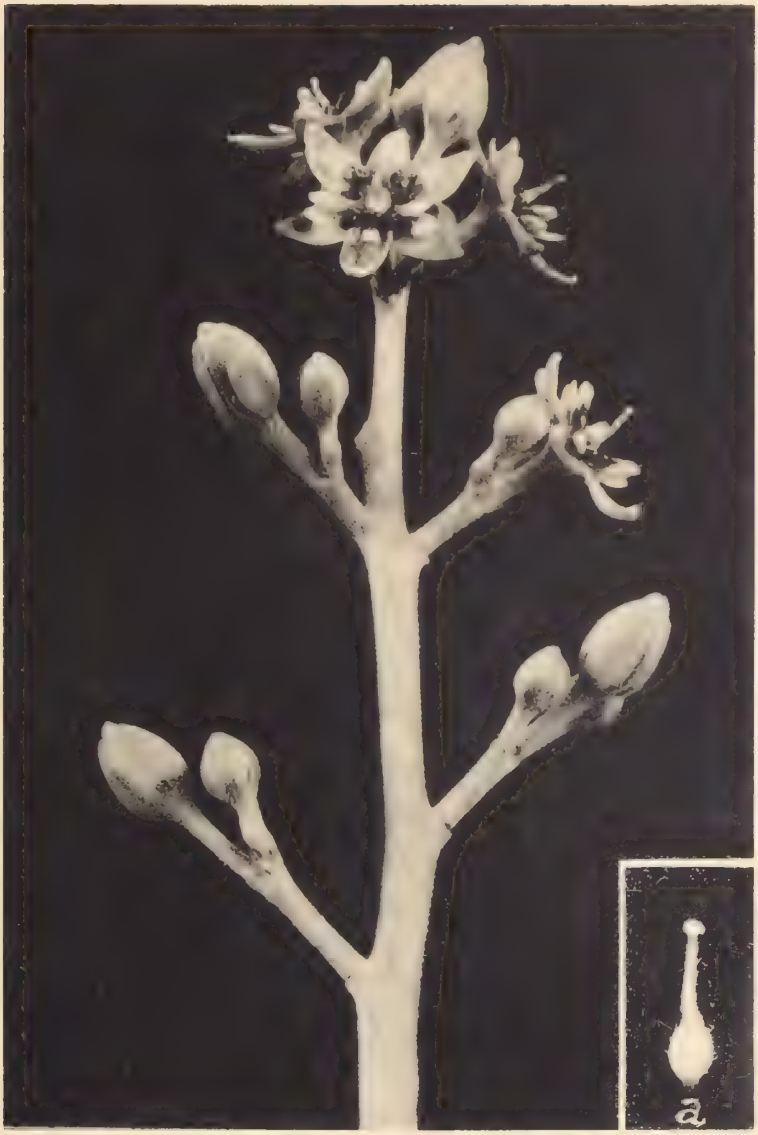
EXPLANATION OF PLATE 24

During normal flower-behavior each avocado flower opens for two different periods. The appearance during the *first* anthesis is shown here (enlarged about 2 times). The stamens do not shed pollen but stand away from the pistil, leaving it exposed and in a position to be pollinated. As shown in the insert, the stigmatic end of the pistil is white and evidently in a condition for pollination. The shape and size of the stigma differ for different varieties and its structure is rather intricate and delicate. During this first opening the flower functions only as a female.

The flowers here shown are of the Taylor variety and the picture was taken at 10:00 A. M. In this variety a set of flowers is open in the first or female opening for several hours each forenoon. These flowers close during midday and open for the second or male opening during the afternoon of the following day.

The male and female organs in each flower develop at different times (a condition known as dichogamy). This limits or prevents self-pollination of individual flowers.

At *a* is shown a pistil with fresh stigmatic surface as it appears in the first anthesis.



STOUT: THE FLOWER BEHAVIOR IN AVOCADOS

COCKAYNE BOSTON

EXPLANATION OF PLATE 25

In the second or male anthesis, avocado flowers are as shown here. The contrast to their appearance in the first opening is marked (compare with PLATE 24). Now the stamens are larger and they are more erect. Part of them stand above and closely about the pistil, which is often discolored and shriveled, as shown in the upper insert. During the second opening pollen is shed by uplifted valves shown here and in the lower insert. In its second opening the flower functions as a male.

The principal stages in the cycle of dianthesis typical of each flower of any avocado tree may be traced in the PLATES 25 and 26 as follows:

No. 1. Flower bud not yet old enough to open.

No. 2. Flower in the first or female opening.

No. 3. Flowers that have been open for the first period and are now closed in the interval before it is time to open for their second period.

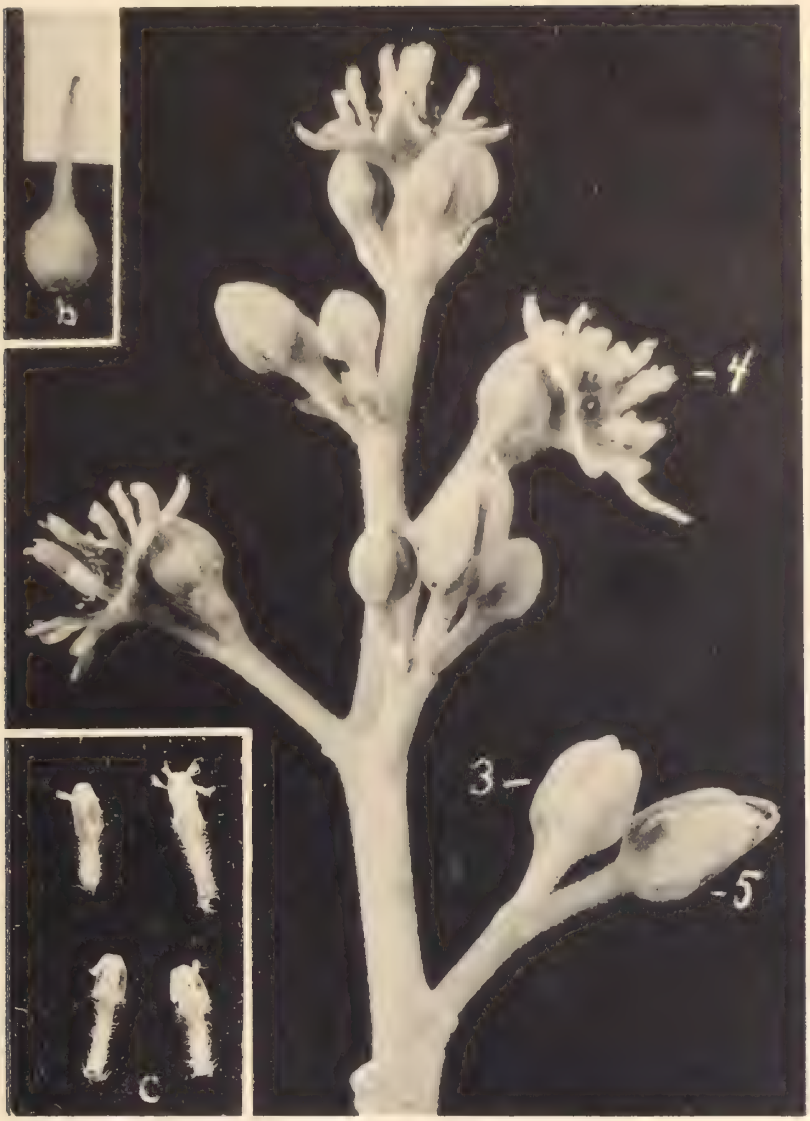
No. 4. Flowers open for the second or male opening.

No. 5. Flowers closed after the second opening. The cycle of flower behavior is complete.

The flowers (except the inserts) here shown are of the Taylor variety and the picture was taken at 3:00 P. M. In this variety normally all the flowers open in the afternoon are those open for the second time. The entire tree functions only as a male in the afternoon. The dichogamy is synchronous. This condition greatly limits or even prevents pollination between flowers of the same tree or of trees of the same clonal variety.

At *b* is shown a pistil at the time of the second anthesis, exhibiting the dead and shriveled tip as it frequently appears at this time.

At *c* are shown several stamens with uplifted valves on which pollen is exposed.



STOUT: THE FLOWER BEHAVIOR IN AVOCADOS

COCKAYNE BOSTON

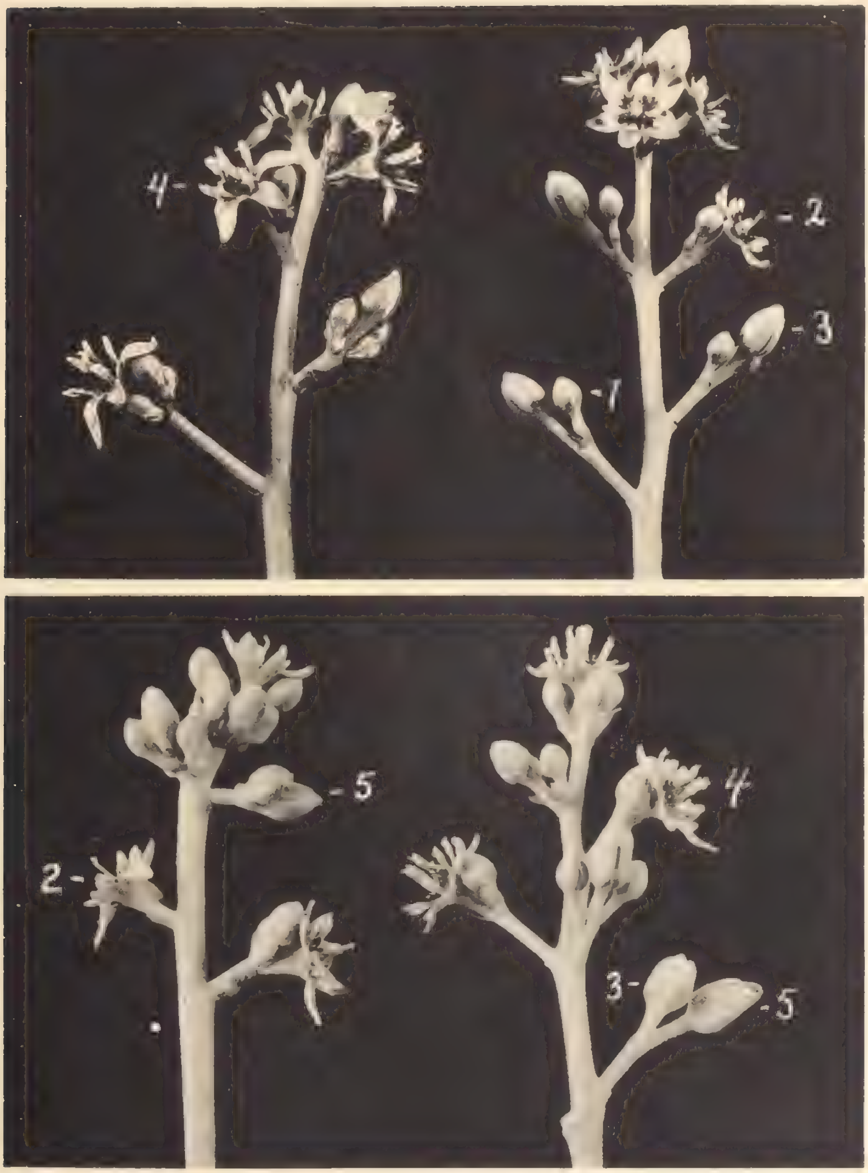
EXPLANATION OF PLATE 26

The reciprocal alternations in the development of sexes as they normally occur each day in the two main groups of avocados are here well shown.

Flowers of Taylor, typical of the *A* varieties, are shown at the right. Flowers of Panchoy, representative of the *B* varieties, are shown at the left. The upper photo is typical for the forenoon, the lower typical for the afternoon. In each photo the two branches were photographed together at the same moment.

In the forenoon, on trees of Panchoy, only flowers in the second or male opening are open and on trees of Taylor only flowers in the first or female opening are open. During midday a shift of sets occurs in each and then in the afternoon the trees of Taylor become male while those of Panchoy become female.

The daily sequence of sets of flowers for Taylor is the reverse of that for Panchoy. In general and under normal flower action the daily sequence of sexes in avocados is either as here shown for Panchoy or as for Taylor. The reciprocating alternations of sex provide for cross-pollination between members of the two groups.



STOUT: THE FLOWER BEHAVIOR IN AVOCADOS

COCKAYNE BOSTON

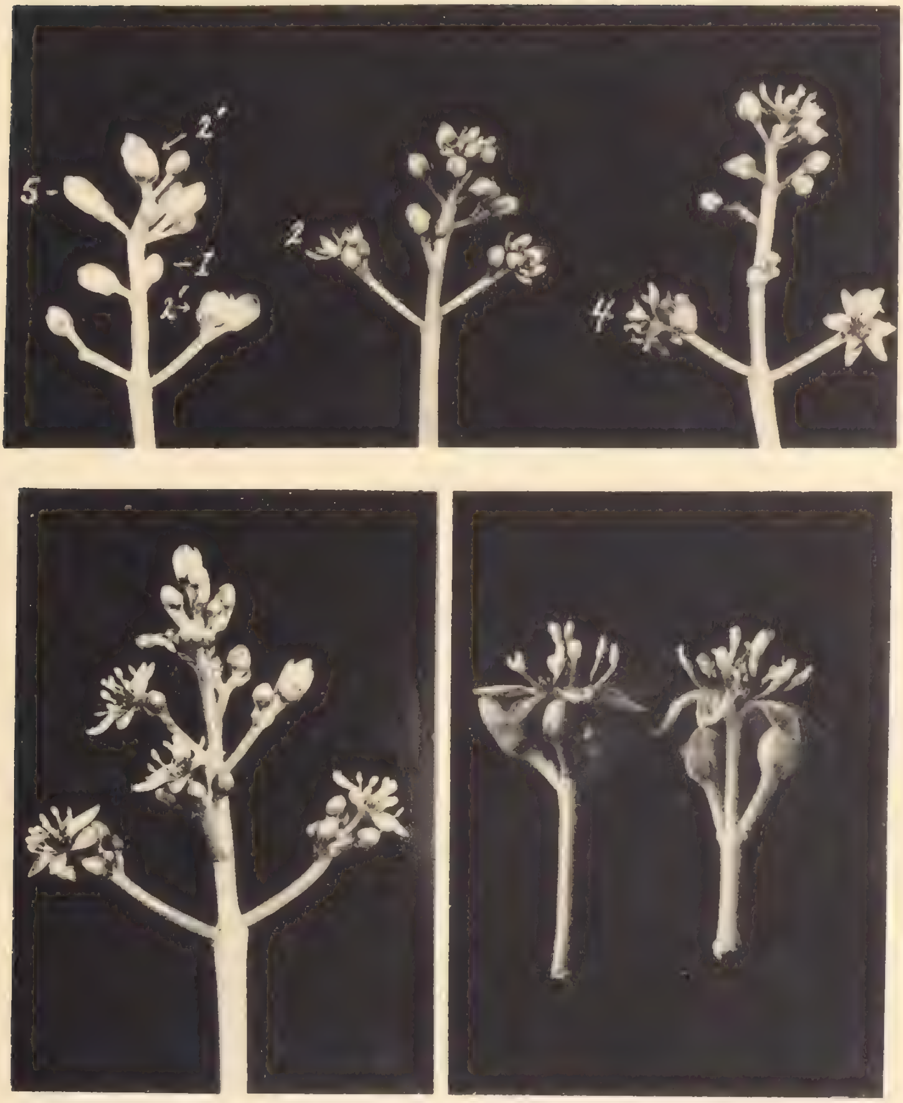
EXPLANATION OF PLATE 27

Upper photo. Flowers of the Trapp variety for which the normal cycle of dianthesis of each flower and the daily sequence of sets are as follows:

A set of flowers begins to open for the first time late in the afternoon —usually not earlier than 3:00 P. M. Then they appear as shown at 2′ on the branch at the left. An hour or so later the flowers are as seen at 2 on the branch in the middle. These flowers close during the night and then the same flowers open for their second or male opening the following forenoon, when they are as at 4 on branch to the right. Only one set of flowers is in action at a time and there is no overlap of sets with opportunity for close-pollination. The opening for the first time late in the afternoon almost prohibits cross-pollination from any of the *A* varieties (see CHARTS 1 to 4) throughout most of the blooming season. But the cycle of sets of flowers is much shorter than that of *A* varieties and of some *B* varieties (see B 1, CHART 5) so it seems highly probable that fruit may set on Trapp to self-pollination while flowers are shedding pollen.

Lower photo. The flowers of the Collinson variety have two periods of opening quite as in other varieties. Stamens are present but they shed no pollen.

At the left is a flowering branch of this variety with four flowers fully open for the second opening. At the right is shown somewhat enlarged a flower of Collinson (left) by the side of a second-period flower of Taylor (right) as the two appear in the afternoon. The uplifted valves carrying out pollen may be seen as finger-like projections from anthers of the Taylor flower. No such valves open from anthers of flowers of Collinson. The anthers remain intact and studies of their structure show them to be merely masses of sterile tissue. The Collinson variety is male sterile.



STOUT: THE FLOWER BEHAVIOR IN AVOCADOS

COCKAYNE BOSTON

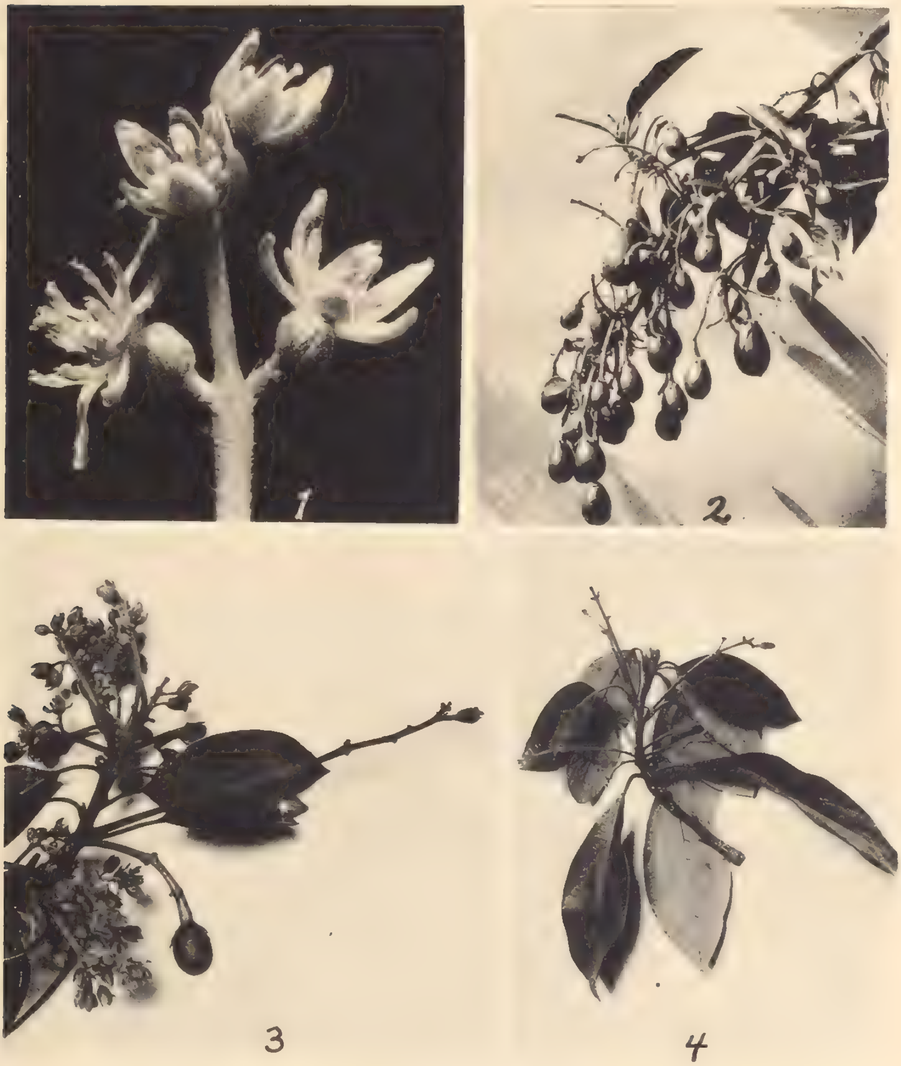
EXPLANATION OF PLATE 28

1. During irregular flower-behavior, flowers are frequently shedding pollen (flower at lower left) while others on the same branch are open for the first or female opening (see flowers at apex of branch). Then there is chance for close-pollination. Such pollinations do not necessarily insure setting of fruit.

2. For some varieties fruits often start to mature to nearly every flower, but most of these fruits soon fall and at the harvest the crop may be scant. This condition has led many growers of avocados to believe that the main problem in avocado growing is to provide cultural conditions which enable trees to hold and mature fruit. This may often be the case. The flower behavior of these varieties is *A* or *B* as for other varieties and is as fully dichogamous. In certain tests, the fruits set when the flowers had been enclosed in bags. Further tests are needed to determine if in these varieties fruit will start to develop without pollination or with only self-pollination and whether adequate yields may be had without cross-pollination.

3 and 4. The flowers of avocados are borne on lateral branches. After yielding flowers for a time, the main axis may produce a few leaves and then resume flowering, as shown here. When the flowering period is over, nearly always an end bud emerges as a vegetative bud, as shown at 4. The fruit therefore hangs from main stems which are leafy at their tips.

The cluster of flowering branches may continue to bloom for several weeks or even months. If as many as two fruits mature in each cluster, the tree bears a large crop. An increase in the number of flowers that are properly cross-pollinated will without a doubt lead to greater setting of fruit.



STOUT: THE FLOWER BEHAVIOR IN AVOCADOS

COCKAYNE BOSTON

EXPLANATION OF CHART 1

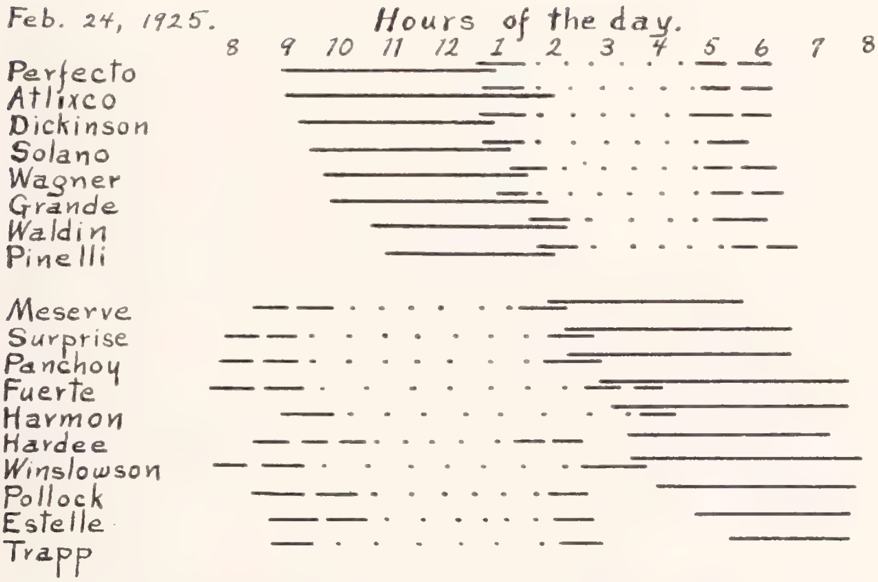
In this chart, as in those following, the continuous line indicates for each variety the *entire* time when flowers were open for the *first* period. The dots indicate the time during which flowers of the *second* period of opening were shedding pollen and the dashes show the intervals of opening and closing before and after pollen was being shed. As a rule the pollen was being shed most abundantly near the middle of the period covered by the dots.

This chart is a record of the flower behavior of 18 varieties for one and the same day. After a minimum of 57° during the preceding night and an early morning fog the day was clear and breezy with a maximum temperature of 85° reached sometime after noon. This record is typical for days of good weather during February, 1925, in Florida.

Every variety studied on this day had two sets of flowers open as indicated. For Perfecto, Grande, and Harmon, there was a short interval when pollen was being shed while first-period flowers were slightly open, otherwise there was no overlap of first-period flowers open while second-period flowers were open and shedding pollen, and no opportunity for self or close-pollination. Thus in avocados, the normal flower-behavior greatly limits self-fruitfulness.

The varieties fall into two groups. Those of one group (*A*) are female in the forenoon and male in the afternoon. The others (Group *B*) are male in the forenoon and female in the afternoon. There is thus a most decided adaptation for reciprocal cross-pollination between certain varieties of the two groups.

CHART 1



A TYPICAL RECORD OF FLOWER BEHAVIOR FOR A DAY OF RATHER FAVORABLE WEATHER RATHER EARLY IN THE SEASON OF BLOOM

EXPLANATION OF CHART 2

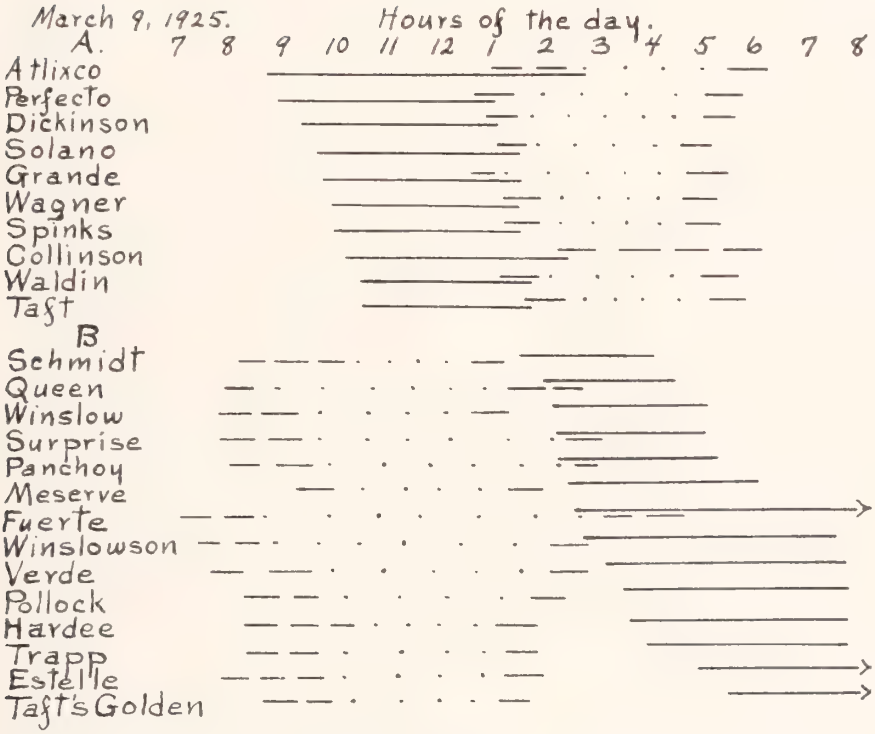
On this day the closing of all sets was observed except for Fuerte, Estelle, and Taft's Golden for each of which the set of firsts had not fully closed at the hour of 8:00 P. M., when the latest observations for the day were made.

For a few varieties (Atlixco, Grande, Surprise, Panchoy, and Fuerte) there was an interval of about fifteen minutes when some pollen of second-period flowers was being shed and first-period flowers were either closing or opening. But for each of these the climax of the first period and the maximum of pollen-shedding were some four or more hours apart. As indicated, Collinson shed no pollen, which is a characteristic of this variety.

For Fuerte the set of firsts remained open all night and until about 10:00 A. M. of the next day and the second opening of this set with pollen-shedding occurred on the 11th. For Estelle and Taft's Golden the set of firsts evidently closed for a period during the night or only partially closed to open fully on the next day as second-period and pollen-shedding flowers.

It will be observed that for several varieties at the bottom of the list of *B* varieties there was an interval of several hours between the closing of the set open in the forenoon and the opening of the afternoon set. This is a marked and normal characteristic of these varieties.

CHART 2



A RECORD FOR TWENTY-FOUR VARIETIES DURING A DAY OF NORMAL FLOWER-BEHAVIOR

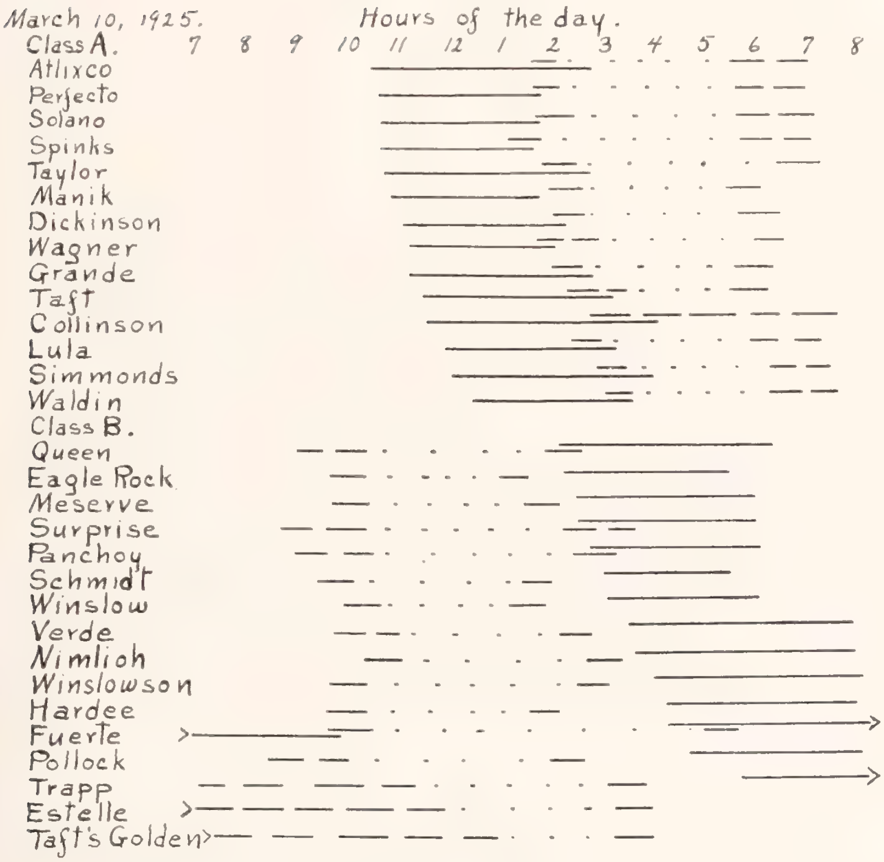
EXPLANATION OF CHART 3

Comparison of this record for March 10th with that for the preceding day (CHART 2) shows a delay on the 10th of from one to two hours in the clock hour when the firsts started to open. The relative behavior of the varieties, however, remains quite the same. This general shift of opening to later hours was due to the fact that the night preceding the 10th was several degrees cooler than were the nights of the 8th and the 9th.

As here shown, the varieties at the lower end of Class *B* are most easily thrown into irregular blooming particularly in the opening of a set for the first period. It was almost 6:00 P. M. when this set started to open on Trapp and evidently this set failed to open on Estelle and Taft's Golden.

A delay of several hours in the opening of flowers by any variety may thus occur from day to day as a result of slight deviations from previous night temperatures. The delay is, however, quite general and uniform throughout, so that the relative behavior of the different varieties remains remarkably the same.

CHART 3



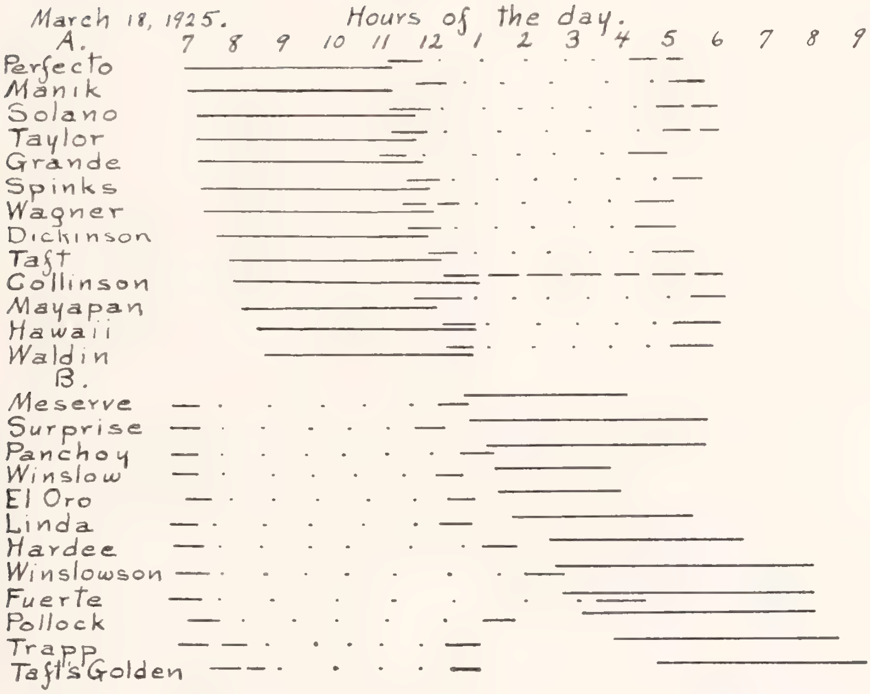
Continuing the record of Chart 2 through the following day

EXPLANATION OF CHART 4

As the season advances to more hours of daylight and higher temperatures the periods of opening for all varieties tend to shift to earlier clock hours. This is readily seen where one compares the record of this chart with that of February 24, especially noticing the hours for those varieties in bloom on both these dates.

It is quite possible that such variations may have a decided influence in determining the time during the entire season of bloom when the pollinations are most readily made and when they are most effective in fruit-setting. It is to be noted that even as late as March 18, for some of the *B* varieties (Taft's Golden, Trapp, and Pollock) the set of first-period flowers open so late in the afternoon that their pollination is difficult for the reasons that at that hour pollen of *A* varieties is very scarce and that the insects which work during the day are now decidedly inactive.

CHART 4



A RECORD OF NORMAL FLOWER-BEHAVIOR FOR A DAY RATHER LATE IN THE SEASON OF BLOOMING

EXPLANATION OF CHART 5

Different types of flowering cycles for avocado flowers are here shown diagramatically. The different conditions through which sets of flowers pass are traced for a period of sixty hours. This shows the complete cycle for at least one set and for such other set or sets as may be in action during this time.

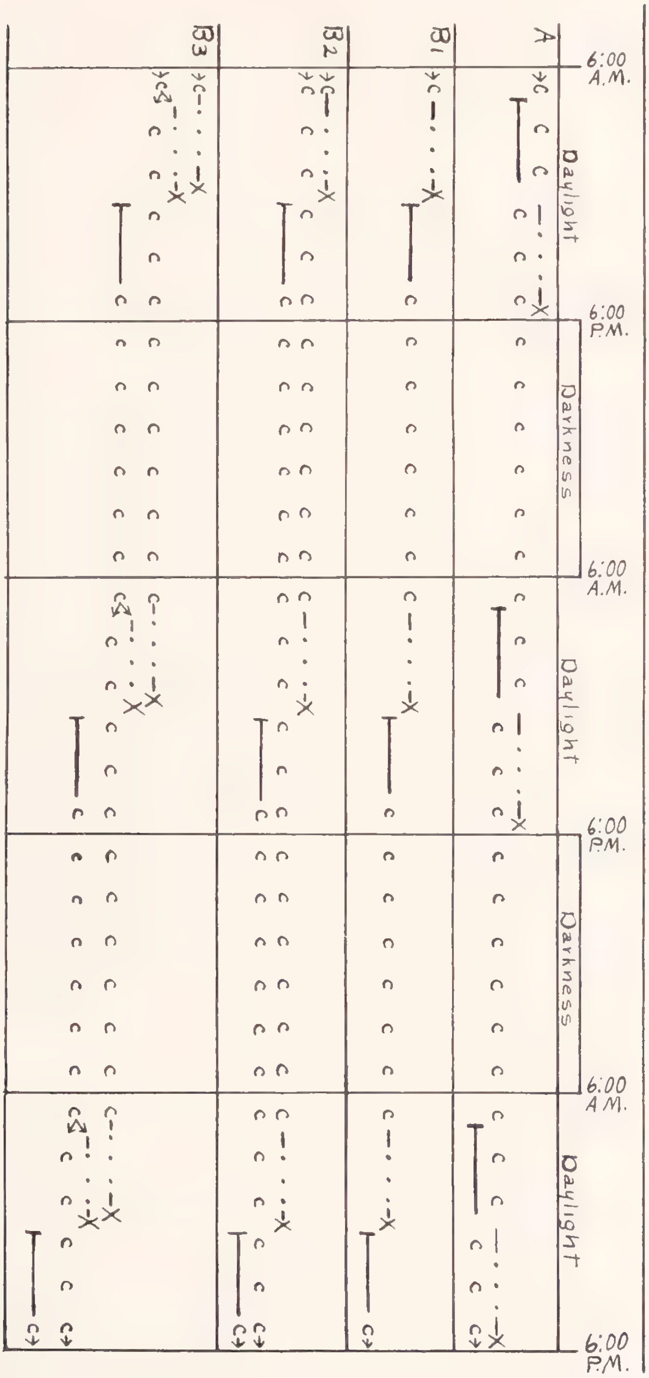
The first or female anthesis is indicated by the continuous line beginning at a bar. Dashes and dots indicate the second opening. The interval between the two periods of opening is shown by the letter *c*. The entire cycle of flower action extends from the bar to the *x*. Sets continuing from previous days or continuing later than the close of the 60 hour period of the chart are indicated by the arrows.

The cycle of dianthesis typical of *A* varieties normally covers about 36 hours. It begins in the early forenoon and ends in the late afternoon of the following day. The female and the male openings are separated by an interval of about 24 hours during which the flowers are closed. The sequence of sets each with this behavior brings two different sets into bloom each day.

Normally all *B* varieties have flowers in the second or male anthesis open during the forenoon and flowers of the first or female opening open in the afternoon. The cycle typical of different varieties may, however, be quite different. For some (see B 1) the cycle covers only 24 hours or less and only one set is in action at a time. For others (see B 2) the cycle of sets extends over 48 hours. The interval between the development of the pistil and the maturity of the stamens covers about 24 hours. For certain varieties a single set of flowers may, at least under certain conditions, divide into two groups of flowers as shown at B 3. One group completes the cycle in 24 hours and the other completes it in 48 hours.

All the different types of flowering cycles here shown may exist when the daily alternation of all the varieties is quite normal. Under abnormal and off-stride blooming the cycles of sets are, of course, also very irregular.

CHART 5


6:00 A.M.
6:00 P.M.
6:00 A.M.
6:00 P.M.
6:00 A.M.
6:00 P.M.
Daylight
Darkness
Daylight
Darkness
Daylight
A
B1
B2
B3

TYPES OF CYCLES OF DIANTHESIS FOR SETS OF AVOCADO FLOWERS

EXPLANATION OF CHART 6

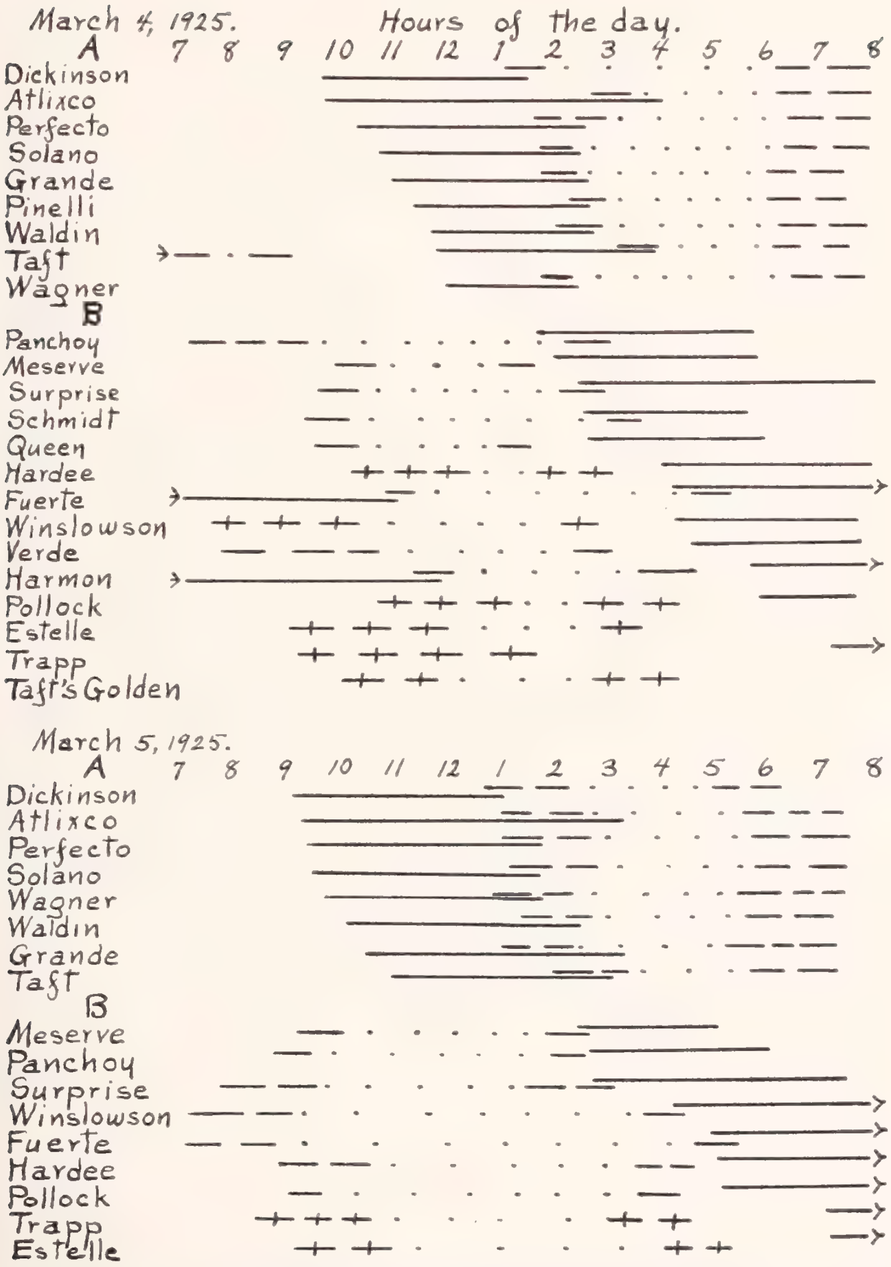
A drop in temperature on March 3rd to a maximum of 77° and a minimum of 46° (about 10° lower than the maximum and the minimum of the previous days) gave the irregular behavior in flower opening recorded in this chart.

On the 4th, the varieties which normally open firsts in the forenoon (Group *A*) went through their daily sequence quite normally and quickly with only a delay of about an hour in starting compared with the record of the previous week. The varieties heading the list of the afternoon first-openers were also near normal stride, but Hardee, Winslowson, Pollock, Estelle, Trapp, and Taft's Golden, produced a set of *single-opening* flowers (indicated by +) which had entirely skipped the first-opening on the 3rd. These flowers shed pollen feebly and those of Trapp shed no pollen at all. Fuerte and Harmon had a set in first-opening continued from the preceding day for a time in the morning, so these varieties had three different sets open during the day. Estelle and Taft's Golden produced no first-period flowers and Trapp only a few up to the hour of the last observation at 8:00 P. M.

With the rising temperature of the afternoon of the 4th and the night following, the flower behavior on the 5th was more nearly normal with a noticeable shift to earlier hours of the day. On Trapp nearly all of the flowers shedding pollen were flowers of a single opening and all those for Estelle were evidently of this type of opening. For this day the set of firsts for Trapp and Estelle started opening shortly after 7:00 P. M. which was after dark.

For only a few varieties and for a short time only (see where dots overlap the continuous line) was there an opportunity for close-pollination.

CHART 6



RECORDS FOR TWO DAYS SHOWING SOMEWHAT DELAYED OPENING, A SKIPPING OF THE FIRST OPENING BY CERTAIN SETS AND SINGLE OPENING

EXPLANATION OF CHART 7

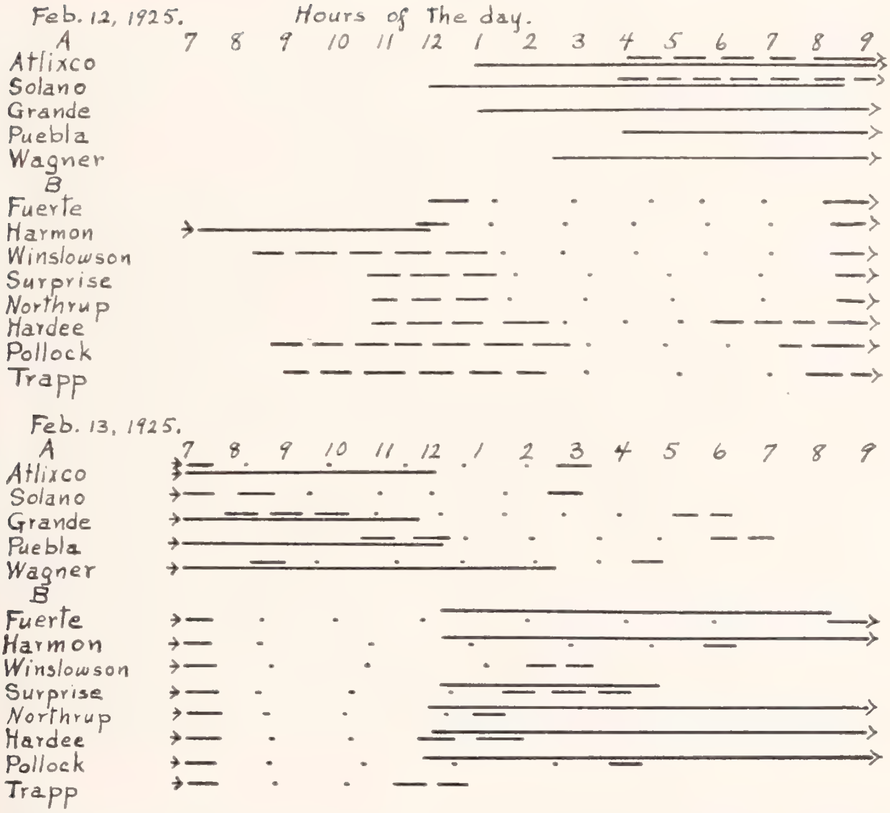
These records for February 12 and 13 show some of the most extreme off-stride behavior observed in Florida during the season of 1925. The weather during the 9th and 10th was warm with maximum temperatures of 84° and 91°. On these days the records of flower behavior were almost identical with that of February 24, shown in CHART 1. Heavy rain on the night preceding the 11th and a shower on that afternoon were followed by clear colder weather and strong northerly winds. The maximum day temperatures were 64° on the 12th and 69° on the 13th and on the night preceding the 13th there was the only frost experienced during the months of February and March in the orchards where the observations were made.

The openings of both first-period and second-period flowers were delayed or even omitted and when they did open the closing was delayed so that in most cases the set or sets open in the afternoon continued thus over night (as shown by the arrows) and most of the following day. On the 12th, only one set of flowers opened for most varieties; in the *A* group the set of first-period flowers opened late and except for Solano remained open all night and into the next day. The second-period set for the *B* varieties also opened late and remained semi-open all night, becoming more open the following day and shedding pollen and closing at the hours indicated.

The two sets of flowers, which in favorable weather would have opened and closed on the 12th, took two days for opening. The first-period set for each of the *B* group was delayed 24 hours. The two sets which in the normal sequence would have opened on the 13th were delayed in opening until a later date.

During much of this time flowers of both sets were only semi-open with feeble and incomplete action of flower parts, and slow, irregular and incomplete shedding of pollen. There was on the 13th a period when the first-period flowers overlapped pollen shedding for Atlixco, Grande, Wagner, Fuerte, Harmon, Winslowson, and Pollock. During such flower-behavior there is, it would seem, chances for self-pollination but the extent to which flowers in such off-stride bloom can function is not yet determined.

CHART 7



RECORDS FOR TWO DAYS SHOWING MUCH OFF-STRIDE AND DELAYED OPENING OF FLOWERS

EXPLANATION OF CHART 8

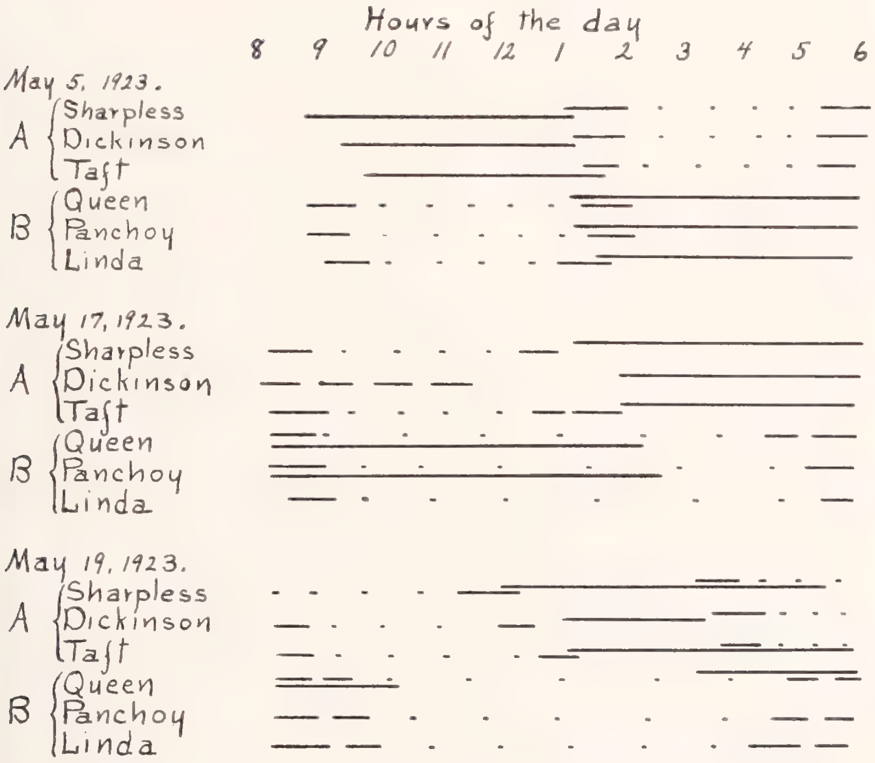
These records obtained in California illustrate how the flower behavior of a single tree may vary from day to day in response to weather conditions.

On May 5th, the daily alternation and sequence of the two sets of flowers were quite normal for all six varieties.

The day of May 17th was preceded by cloudy weather with some rain and with lower than usual temperatures. The day was cool and mostly cloudy. The daily sequence for the three *A* varieties was the reverse of the normal. For them, in the forenoon, second-period flowers delayed from the previous afternoon were open and in the afternoon first-period flowers delayed from that forenoon were open. For each of the *B* varieties second-period flowers opened in the morning as is normal for this group but they remained open all day, shedding pollen poorly. Only flowers of this set opened on Linda but for Queen and Panchoy a set of first-period flowers delayed from the previous afternoon were open all forenoon.

Inclement weather continued until the early forenoon of the 19th when the clouds cleared and the temperatures rose decidedly. On this day each of the three *A* varieties had three sets open; (1) a set of second-period in the forenoon continued or delayed from the previous day; (2) a set of first-period flowers delayed from that forenoon, and (3) a set of second-period flowers delayed for that afternoon. Of the *B* varieties, Queen and Panchoy had only one set of flowers which had probably skipped a previous opening. But Queen had three sets in nearly the reverse sequence of the three sets of opening on the *A* varieties that day.

CHART 8



RECORDS OF FLOWER BEHAVIOR FOR SIX TREES ON THREE DIFFERENT DAYS

EXPLANATION OF CHART 9

Here are grouped the records for the variety Taft for the different days of observations during the season of 1925. These records are all from observations made on one tree with, however, frequent check comparisons on numerous other trees of this variety. As shown there was only one day (March 11) when the firsts of the forenoon were all fully closed before the seconds started to open. There was, however, but one day (February 25) when the latter were observed to shed pollen for a short time while firsts were still open.

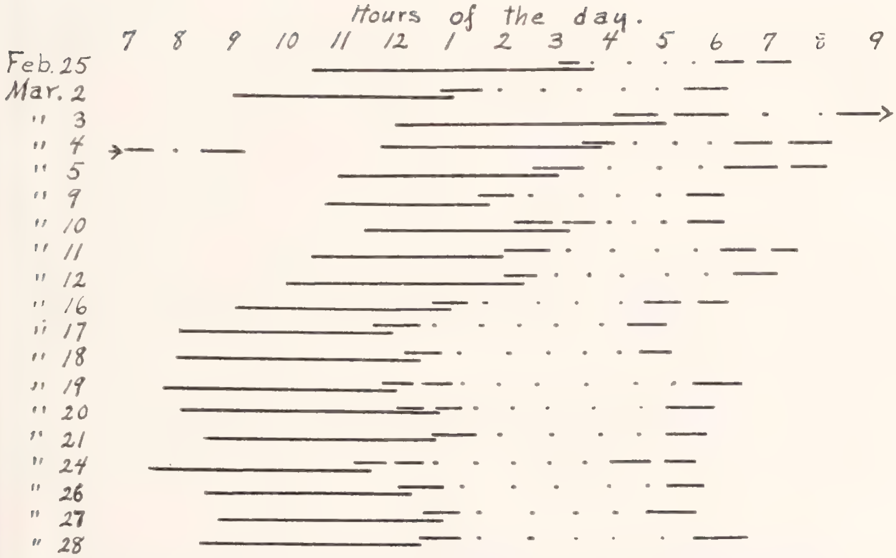
A few days of unusually warm weather early in the season of bloom brought the periods of opening rather early in the day. Then cooler weather came and the hours of openings were decidedly later in the day, but from then on to later dates there was a steady advance to earlier hours as indicated, with, however, variations from day to day with deviations in weather.

In only one set of flowers was there a noticeable irregularity; the set in the second period of opening on the afternoon of March 3rd remained open over night and shed some pollen early the next forenoon.

The record shows a most decidedly exclusive opening of the two sets with extremely rare chances for any close-pollination.

This variety has first-flowers opening in the forenoon. These flowers close about midday and remain closed all afternoon, all night, and all the next forenoon. Thus they open and shed pollen in the afternoon some 25 hours after the first closing and apparently some 26 hours after the point of highest receptivity for proper pollination. Self-pollination seems almost impossible in this variety and in others with similar flower behavior. It is not surprising that a tree of the Taft variety set very few fruits in the tenting test and that isolated trees and solid blocks of the Taft variety should be repeatedly shy in bearing.

CHART 9



Records of the flower behavior for trees of the Taft variety for the season of 1925

EXPLANATION OF CHART 10

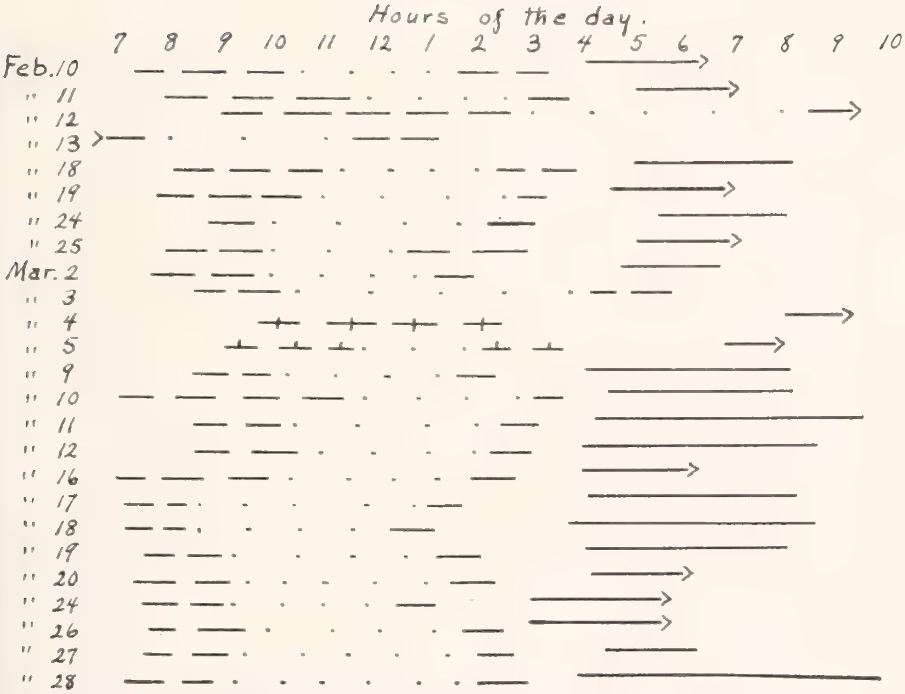
As shown here in this record for the season, the trees of Trapp under observation went through the season of bloom without a single moment of time when firsts and seconds were open together. The seconds shed their pollen during the forenoon and were through and fully closed (see upper view in PLATE 27) from 45 minutes (February 10) to as long as three hours (March 2nd) before the firsts began to open. There was on the basis of this record never a chance for close-pollination.

In comparison with most other varieties of Class *B* the Trapp has the first-period anthesis start late in the afternoon when there is only little pollen being shed from *A* varieties and when the activities of the insects usually working avocado flowers are greatly reduced. Frequently the firsts open after dark but on most days they were fully closed when observations were made as late as 9 : 00 P. M., and with one exception they were fully closed when observations are made before 7 :00 o'clock A. M. the following day.

In off-stride blooming a set of flowers in the second period of opening may remain open and shed some pollen for the greater part of two days (see February 12 and 13th) during which no firsts open. A set which skipped first opening may open as *singles* the next day but fail entirely to shed pollen (see March 4th), or such a set or part of a set may shed some pollen (see record for March 5th).

If fruit will set on trees of the Trapp without cross-pollination, it seems certain that the opening of firsts late in the afternoon with the next opening on the following forenoon, in this variety at least, favors self-fertilization. It is, however, possible that some fruit may set without any fertilization.

CHART 10



Records of the flower behavior for trees of the Trapp variety for the season of 1925

DESCRIPTIONS OF NEW GENERA AND SPECIES OF PLANTS COLLECTED ON THE MULFORD BIOLOGICAL EXPLORATION OF THE AMAZON VALLEY, 1921–1922

By H. H. Rusby, M.D.,
Director of the Expedition

(WITH EIGHT TEXT-FIGURES)

The itinerary of the Mulford Expedition was fully described, and a general account of the floral features of the regions traveled was given in the *Journal of The New York Botanical Garden* for August, 1922, pages 101–112. For the benefit of those who have not this publication at hand, the following brief résumé is presented.

Collections began in early July at Pongo de Quime, a settlement just across the crest of the eastern Cordillera, at an altitude of some 15,000 feet, about 40 or 50 miles east of Eucalyptus, a station on the Antofagasta-La Paz Railroad, and at the head of the Quime River. As a matter of fact, the very first plants, cactus and *Caiophora,* were collected at a point more than a thousand feet higher. At that season, the beginning of winter, and at that altitude, the edges of the streams in the vicinity were ice-bound, but these plants, cuddled under the edges of rocks, and exposed to strong sunshine, managed to expand their brilliant blossoms. The journey from Pongo to Canamina, having an altitude of 3,500 to 4,500 feet, lay alternately along the valley streams and across high ridges, and occupied about four days. During this time, I was extremely ill and without any great hope of surviving to reach my destination, so that collecting was impossible and but little note could be taken of my surroundings. Dr. White, who followed a few days later, made a small but interesting collection along this route. From Canamina to Espia, about 500 feet lower, the journey lay along the Canamina and Meguilla Rivers. Both at Canamina and along this route, we made rather extensive collections. At Espia, where the Meguilla and La Paz rivers unite to form the Bopi, we remained for some time, awaiting rafts. Unfortunately, this occurred during the dry season and the conditions were extremely arid at this point, so that but few specimens were obtained. From Espia, the remainder of the journey was entirely by water, until we reached Rurrenabaque, having an altitude of about 1,000 feet, and lying among the foothills at the eastern base of the Andes. The flora of the stupendous mountains amidst which this river winds its tortuous course is wonderfully rich and must contain hundreds of unknown plants, but owing to the forced rapidity of this portion of our journey, our collections had to be confined almost wholly to the river margin. At Huachi, near the head of the Beni River, we made a stop of several weeks and collected energetically, not only in the river valley, but among the neighboring mountains. A very rich and interesting collection was here obtained. The journey thence to Rurrenabaque was again a rapid one, but at the latter point, we stayed for many weeks and made large collections. From here an overland journey was made to Lake Rogagua, in the midst of the pampas, and about midway between the Beni and the Mamoré Rivers. This trip occupied the latter part of October. Although it was early spring and flowering plants were not abundant, we collected industriously, both going and returning. Arrived again at Rurrenabaque, we found the November flora exceedingly rich and attractive, and accumulated a large collection. Considering the fact that I had collected extensively in this region in 1886, that Mr. Bang had spent much time there during many seasons, sending me large numbers of his plants, and that Mr. Williams had also done considerable work in the same region, I was hardly prepared to find the collections made there on this occasion presenting so large a proportion of novelties as is the case. It is my opinion that we do not yet know much more than half of the flowering plants of that locality.

After my separation from the party, in December, Dr. White and Mr. Cardenas continued collecting. They also made important journeys to Tumapasa and Ixiamas, and did considerable collecting on the lower Beni and its tributaries in January and February of 1922.

The study of the Mulford Collection of plants has occupied all the spare time of the writer since his return in February, 1922. Progress has been delayed for the reason that much critical study has been devoted to the previous collections of related plants of the same region, made by Miguel Bang, R. S. Williams, Otto Buchtien, myself, and others. My intention has been to publish a comprehensive account of all these collections, giving their geographic range, ecologic conditions, and economic relations, with special attention to the transition flora between the forested regions and the pampas, a study of the greatest interest. This undertaking is so extensive, and my time is so limited, that it now appears desirable to effect publication of the new forms already determined and later to continue with the more comprehensive work.

It is not to be understood that the present publication will exhaust the list of either new genera or species of the Mulford collection. The 2,400 collection numbers probably represent about 1,500 species. Of these, more than a tenth have been laid aside until the conditions are more favorable for their exact determination. Doubtless a large part of them will be found without published names or descriptions, and several new genera will probably be found among them. In the meantime, it seems highly desirable that the many botanists now working on tropical American plants should possess what information I can supply regarding those already studied.

The following facts should be understood as applying to all the species herein described.

Unless otherwise stated, (1) all were collected in Bolivia, and all by the Mulford Exploration, and they should be so cited; (2) all names are of my own authorship; (3) all type-specimens are to be found in the herbarium of The New York Botanical Garden.

Owing to a degree of physical incapacity, I was unable to exert myself on this as on previous journeys, so that the number of duplicates available for distribution was relatively small. Dr. Orland E. White, of the Brooklyn Botanic Garden, and Mr. Martin Cardenas, a botanical student encouraged and aided by the Bolivian National Department of Education, were exceedingly energetic and untiring in their work, but could not fully supply the deficiency in my service. The duplicates secured, about 15,000 in number, have been distributed with great care by the H. K. Mulford Company to the Brooklyn Botanic Garden, the United States Department of Agriculture, the Gray Herbarium of Harvard University, and the Philadelphia Academy of Natural Sciences, in this country, besides small sets to the Field Museum and to several specialists. Besides small packages sent to various European specialists, rather large sets have gone to the Royal Botanic Garden at Kew, the Berlin Botanic Garden, and the National Museum at La Paz, Bolivia.

The collection here described is of peculiar interest, because of its many structures which disagree with existing knowledge of the respective groups to which they belong. A diandrous *Costus*, a scandent *Ruprechtia*, an arborescent *Acacia* with climbing branches, a *Borreria* bearing glands on the face of its petals, a dioecious *Seemannia*, a *Solanum* with sagittate dehiscent anthers and the filaments of *Bassovia*, are but a few of the anomalous structures described in the following pages, which start one on fresh speculations as to the nature of generic limitations. In reviewing these phenomena, as well as many which relate to specific demarcations, one can but smile when he thinks of the dictum that constitutes the stronghold of "anti-evolutionists," that everything is made after its kind and stays so made!

DESCRIPTIONS OF NEW GENERA AND SPECIES

ALISMACEAE

Alisma boliviana

Glabrous. Leaves numerous, erect when young, later spreading widely, the petioles to 6 cm. long, slender. Blades 2 to 3 cm. long, 6 to 9 mm. wide, lance-oblong, acuminate and acute, the base very gradually tapering into the petiole. Inflorescence much exceeding the leaves, mostly compound, peduncled, the whorls sometimes with more than 20 flowers, bracted, the bracts sessile, broadly ovate and acute. Pedicels very unequal, to 3 cm. long, filiform, the base of the flower truncate, slightly intruded. Sepals 2 mm. long, broadly ovate, acute, thick. Petals white, hyaline, twice the length of the sepals. Stamens 6, the anthers white, broad and thin, equaling the sepals in length. Pistils 1 mm. long, the very short, slightly recurved style subterminal, at the inner edge of the summit.

On the margin of a lake near Reyes, 1000 feet, *Rusby and White,* October 25, 1921 (*no. 1540*).

This species grows in company with *A. tenella* Mart., and so closely resembles it that some doubt existed at first as to their representation of two species.

ARACEAE

Xanthosoma syngoniifolia

Stems, petioles, etc., scabrellate. Rhizome densely tuberiferous, compact, bulbiform, about 4 cm. broad, the roots emanating from its upper surface. Basal sheaths several, 3 to 6 cm. long, triangular, acuminate and acute, rigid, finely many-nerved. Petioles to 6 dm. long, erect, slender, gradually and regularly broadening downward into a sheath. Leaf-blades thin and membranaceous, trifoliolate, the middle lobe sessile, entire, 15 to 20 cm. long, 5 to 10 cm. broad, obovate with cuneate base and very short-pointed acute summit, pale beneath, the venation slender, reticulate, the principal secondaries about 8 or 10 on each side, their ends united by an undulating intramarginal line, another similar but more slender line close to the margin; lateral leaflets on short unequal winged petiolules, of two leaflets, the inner mostly sessile, the outer with a short petiole-like base, occasionally bearing a small basal leaflet or lobe on the outer side; segments all similar to the terminal, except that the outer are successively smaller and indistinctly dentate. Peduncle solitary (?), nearly as long as the leaves, slender, fleshy, distinctly articulated above the middle, where it is sharply deflexed, the joint fissured and open on the inner side and glandular. Spathe somewhat exceeding the spadix, convolute, at maturity straight, 15 cm. long, constricted at the summit of the lower third, which is closed about the pistillate inflorescence, the edges widely overlapping; in its closed form, ovoid and a little broader than the upper portion, which is 3.5 cm. broad, lanceolate or ovate, somewhat concave, acuminate, acute, thinner than the basal portion, greenish-white. Spadix adnate to the spathe by the dorsum of its base, its pistillate lower portion about 2.5 cm. long, about 1 cm. broad; sterile portion a little longer, about half as thick, scaly at the base, narrowed upward; staminate portion 7 or 8 cm. long, nearly 1 cm. thick, narrowed at base and summit.

Ovaries wholly distinct, obconic, the white terminal disk-like body wider than the ovary. Stamens 6, coherent at the summit into a disk-like whitish body which is vertically elongated, rhomboidal, about 4 mm. long and 2 mm. wide.

Collected by Martin Cardenas, in copses on the pampas near Lake Rogagua, 1,000 feet, November, 1921 (*no. 1436*) and at the same place on November 7 (*no. 1693*).

Species allied to *X. helleborifolia* Schott.

Taccarum caudatum

Glabrous throughout. Petiole and peduncle arising together from the summit of the corm; when young, both enclosed in a broad obtuse membranaceous, and at length scarious sheath. Petiole 8 dm. long, 3 cm. thick at the base, 1 cm. at the summit, terete, green or purplish-blotched. Leaf peltate, 3-parted, the divisions 3 dm. long and as broad or broader, sessile, bipinnate, the pinnatifid pinnae separated by one or more small simple ones. Ultimate segments very unequal, the lower smaller, lanceolate or oblanceolate, acuminate and acute, entire, bright-green, the midrib and secondaries impressed above, prominent beneath, the latter 3 or 4 on each side. Relative length of peduncle variable, usually about 2 dm. long, about half as thick as the petiole, terete. Spathe convolute below, open above, extending to the base of the staminate portion of the spadix, thin, inflated, becoming scarious, and at length deciduous, broadly obtuse at the summit, the base very oblique, one side dropping much below the base of the spadix. Pistillate portion of spadix 1 dm. long, 1.5 cm. thick, densely flowered. Staminate portion nearly 2 dm. long, 1 cm. thick at the base, tapering regularly to the summit, not very densely flowered, deciduous or decaying after flowering.

Staminate Flowers.—Stamens 10, contiguous but distinct or nearly so, borne on a stipe 1 cm. long, this thickened upward, where it is irregularly sulcate, green or purplish, the summit expanded into a fleshy receptacle with tumid summit slightly surpassing the anthers and of blackish color. Anthers oblong, sessile, so crowded as often to be forced out of position, 2 mm. long, the mass 4 mm. broad.

Pistillate Flowers.—Sessile, subtended by 4 or 5 staminodia, which are appressed and about two-thirds the length of the ovary, their lower portions pale, thin, 2.5 mm. broad and nearly triangular in form, connate beneath the ovary, the upper portion purple, narrowed, and the obtuse summit dilated. Ovary bright-green, 5 mm. broad and about half as long, 4- or 5-lobed, the lobes rounded on the back, the summit nearly plane. Style 4 mm. long, stout, white, fleshy. Stigma yellow, glutinous, 2.5 mm. broad, lightly 4- or 5-lobed.

Corm 8 cm. broad, 3.5 cm. high, the base broadly rounded, the summit nearly plane, surmounted by a dark-colored disk 3 cm. broad and 1 cm. high, from which emanate a number of thin white rhizomes about 6 cm. long, which bear the fibrous roots.

The description is drawn from the living plant in the conservatory of The New York Botanical Garden. Collected by the author at Rurrenabaque, 1,000 feet, October, 1921. Growing in damp soil along a roadside through the forest. Also collected by O. E. White in the same locality, November 30 (*no. 2302*), and at Huachi, 3,000 feet, September 24 (*no. 1077*). Species nearest to *T. Hasslerianum* Chodat, which has a similar slender staminate portion of the spadix.

In Bolivia, this corm is known as "solimán," a name that is applied to a number of Araceous rhizomes, as well as to *Hura.* These Araceous products are said to be used in the manufacture of arrow-poisons, but the native information regarding their use appeared rather indefinite.

MAYACACEAE

Mayaca boliviana

Glabrous, with the exception of a few scattered hairs upon the leaf-bases. Stems mostly 3 to 5 cm. long, stout, pale-green, densely leafy. Leaves deep-green, sessile, 3 to 6 mm. long, the larger nearly 1 mm. wide at the base, tapering regularly from the base to the attenuate summit, the slender midrib prominent. Peduncles slender, erect-spreading, 4 to 6 cm. long. Sepals strongly reflexed, 3 mm. long, less than 1 mm. wide, tapering regularly from the base, obtusish. Petals 5 mm. long and wide, obovate with rounded summit, deep-pink, finely 7- to 9-nerved. Stamens 3 mm. long, the slender filament a fourth of the length and about as long as the broad terminal appendage, which at length divides into two. Ovary about as long as the filaments and as broad as long, the filiform style a little longer than the stamens, the stigma obscurely 3-lobed.

Growing in muddy margins of pools, in small clumps, not common, at Ixiamas, 700 to 800 feet, *O. E. White,* December 17, 1921 (*no. 2312*).

Bromeliaceae

Aechmea ellipsoidea

(Fruiting specimen.) Lower leaf-surfaces and younger parts gray-furfuraceous, the inflorescence white-floccose. Leaf (but one seen) probably 8 dm. or more long, the lower portion wanting, 5 cm. wide, ligulate, shortly and stoutly cuspidate, serrulate with falcately ascending pungent teeth about 2 mm. long and a little more than 1 cm. apart; thin and semi-rigid, finely many-nerved and lightly channeled, pale-green above, gray-green and moderately furfuraceous beneath. Stem (only the upper 3 dm. seen), stout, erect, densely clothed nearly to the summit with erect or appressed, imbricated bracts, the uppermost and smallest of which is 4 or 5 cm. long and more than one cm. wide, lanceolate, with clasping base and attenuate summit. Spike solitary, terminal, ellipsoidal, 7 cm. long, 3 cm. thick, the flowers densely crowded. Peduncle short, very stout, densely floccose, the rachis 2 mm. thick. Bracts floccose, closely enclosing the capsule, 2- or 3(?)-lobed, concave on the back, where the neighboring capsule adjoins it, the concavity winged. Capsule 1.5 cm. long and half as wide, ovoid, somewhat angled. Persistent calyx-lobes 6 mm. long, black, minutely papillose, ovate, obtuse, erect, thick and coriaceous. Seeds 3 or 4 mm. long, stipitate, compressed-triangulate, obtuse, papillose.

Near Asunto, 2,800 feet, *O. E. White,* August 6, 1921 (*no. 633*).

"Common in leaf-mould, in damp shady woodlands; about 4 feet high."

Guzmania obtusa

Pale-green, glabrous and appearing as though glaucous. Leaves densely imbricated at the base, mostly shorter than the spike, to 17 dm. long and 3 cm. wide, linear-oblong, or oblanceolate, acute, dilated at the base, thin, finely many-nerved. Stem in my specimen about 2 dm. long, inclusive of the spike, stout, completely clothed with imbricated and appressed bracts about 3 cm. long and 1 to 2 cm. wide, the lower ovate, acuminate and acute, the middle obtuse but with a terminal awn, gradually passing into the floral bracts, which are more than 3 cm. broad and but little longer, and obtuse, thin, and reddish or purple. Calyx 2 or 2.5 cm. long, the sepals rigid, lanceolate, attenuate, the corolla one cm. longer. Stamens and style about equaling the petals, or nearly so, the style blackish below, white toward the summit.

Rurrenabaque, 1,000 feet, *O. E. White,* November 25, 1921 (*no. 1811*).

"Epiphytic on trees in dark shady ravines."

SMILACACEAE

Smilax flavicaulis

Glabrous, the stems terete, light-yellowish-brown, finely many-ribbed. Spines few, strongly compressed laterally, small and nearly as broad as long. Tendrils simple, terete, not greatly elongated, borne near the middle of the petiole, which is 1.5 to 2 cm. long, flattened, the margins strongly involute, the base clasping and spinose-auriculate. Leaf-blades 7 to 15 cm. long, 4 to 8 cm. broad, varying from lanceolate or even oblong to broadly ovate, mostly acute, with rounded or truncate base, thick and coriaceous, the venation sharply prominent on both sides, especially beneath, a pair of strong nerves or ribs starting at some distance above the base and converging at the apex, a pair of slender nerves starting very near the base and becoming submarginal, all connected by a strong and close reticulation. Peduncles simple, axillary, 2 to 4 cm. long, slender, strongly vertically flattened. Umbels simple, densely many-flowered, the pedicels about 1 to 1.5 cm. long, more or less flattened, ribbed, the basal bracts numerous, shortly triangular, subulate, acute. Flowers not seen. The young fruits are shortly and stoutly stipitate.

In dry places on the pampas about Lake Rogagua, 1,000 feet, *H. H. Rusby,* November 8, 1921 (*no. 1698*).

AMARYLLIDACEAE

Atamosco microcarpa

Glabrous. Bulb spheroidal, 2 to 3 cm. long. Leaves 1 dm. or more long, sometimes equaling or exceeding the flower, narrowly linear, obtuse. Scape filiform, one-flowered. Bract solitary, 2 cm. long, 2 mm. wide, lance-linear, the summit bifid, the teeth obtuse. Peduncle filiform, 3 cm. long. Ovary 2 mm. long.

broadly oval. Perigone scarcely declined, 3.5 cm. long, apparently divided about half way to the base, the lobes 5 or 6 mm. broad, acutish. Stamens unequal, the longest nearly twice as long as the shortest, the anthers about 3 mm. long, strongly recurved. Style filiform, erect, 5 mm. longer than the longest filament, the linear branches recurved. Leaves fully formed at the time of flowering. Flower pink.

Among the grass on open pampa, near Lake Rogagua, 1,000 feet, *M. Cardenas,* November 1, 1921 (*no. 1396*).

LEPIDOPHARYNX gen. nov.

Tube of the perigone very short, clothed with scales within at the summit. Perigone declined or deflexed at the base, the segments elongated, linear, spreading. Petals and sepals similar, the petals narrower and slightly longer, the upper sepal and two upper petals slightly longer than the others. Crown reduced to a ring of scales in the throat. Stamens 6, a little shorter than the longer petals, the alternate ones differing slightly in length. Filaments dilated at the base, but distinct except where adnate to the perigone tube. Anthers oblong, attached near the middle, apparently versatile. Ovary wholly inferior, 3-celled, the ovules anatropous, numerous, in two series in each cell. Style filiform, exceeding the perigone. Stigma dilated upward, truncate, obscurely 3-lobed. Capsule loculicidal. Seeds anatropous, very numerous, triangular, vertically flattened.

Bulb solid, tunicated. Leaves all radical, erect, oblanceolate, appearing with the flowers or later. Scape naked, hollow. Flowers in a terminal umbel, apparently always 4, diverging in pairs. Involucre double, the outer of two lance-linear bracts, which are at length reflexed, the inner of (always?) 4, which are narrower, and erect. Pedicels elongating during and after flowering, the ovary at first more or less reflexed, becoming erect, straight or at first somewhat curved. Flowers looking obliquely or even directly downward, deep red, the lower portions sometimes greenish, the outer portions lighter red or orange.

Genus near *Elisena* and at first mistaken for it, but all the species of that genus have white flowers, with a distinct crown, here represented by an irregular collection of scales in the throat.

Lepidopharynx deflexa

Bulb ovoid, about 7 or 8 cm. long and nearly as broad, some of the inner scales slightly pilose at base. Leaves to 3 dm. or

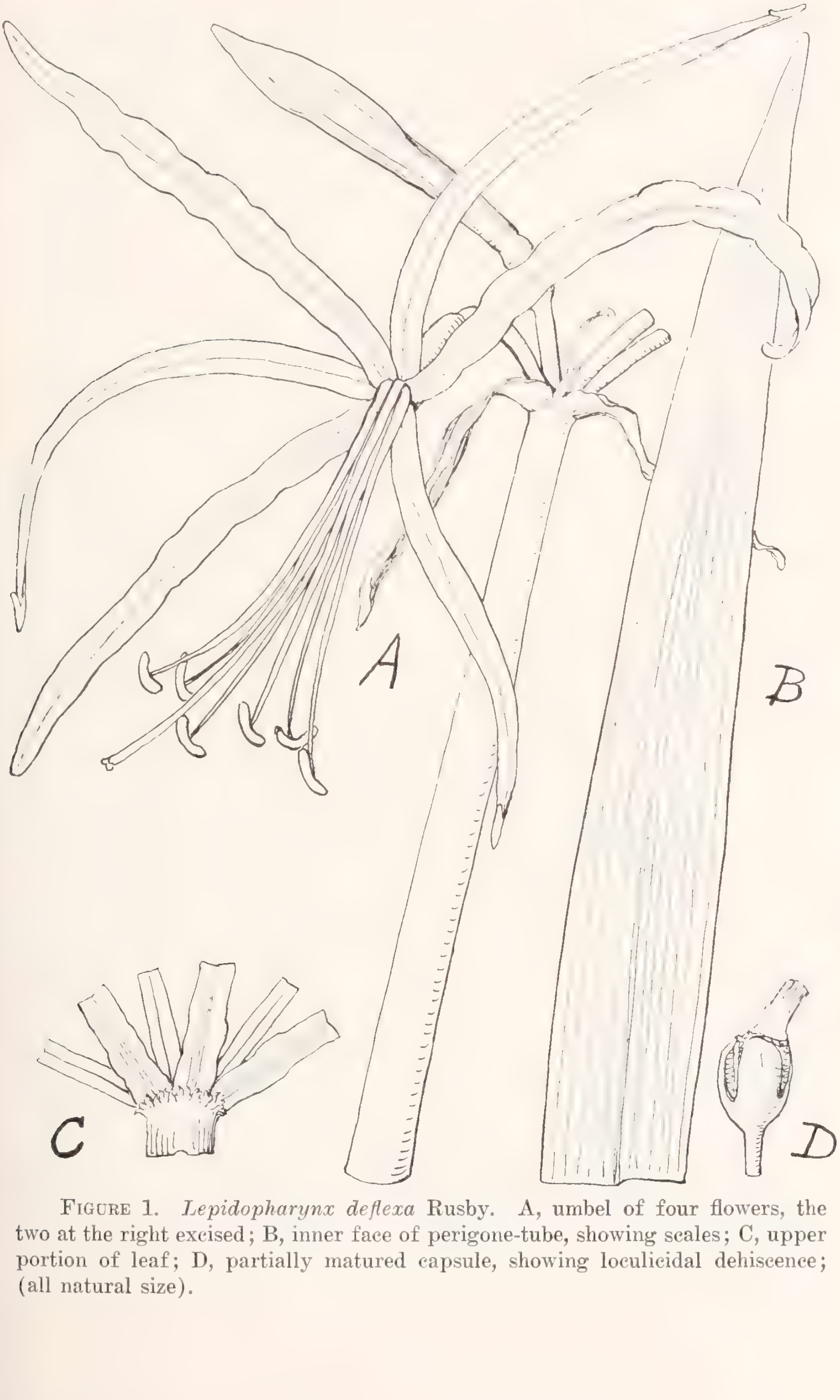


Figure 1. *Lepidopharynx deflexa* Rusby. A, umbel of four flowers, the two at the right excised; B, inner face of perigone-tube, showing scales; C, upper portion of leaf; D, partially matured capsule, showing loculicidal dehiscence; (all natural size).

more long, 2 cm. broad, oblanceolate, acuminate, but obtuse, entire, glabrous, thickish, about 40-nerved. Scape about 6 dm. high, nearly 1 cm. thick at the base, regularly narrowed upward, terete, apparently hollow. Outer bracts 5 or 6 cm. long, slightly imbricate at the base, from which they taper regularly to the acute summit, thin and membranaceous, many-nerved, spreading and at length reflexed. Inner bracts erect, narrower and shorter. Pedicels rather slender, straight or nearly so, about 2 cm. long, in flower. Ovary nearly 1 cm. long, oval or slightly obovoid, slightly triquetrous, 6-nerved. Longest sepal 8 or 9 cm. long, 6 or 7 mm. wide at the base, from which it tapers regularly to the summit, red with a deeper-colored broad middle portion, the others slightly shorter. Petals similar but narrower and more attenuate. Anthers 3 mm. long. Style and stigma 1 cm. longer than the longest petal, the stigma 8 mm. long, white and hyaline. Capsule, immature but dehiscing under pressure, 1 cm. long and nearly as broad.

Espia, 3,500 feet, *H. H. Rusby,* August 8, 1921 (*no. 150,* the type). Growing on steep rocky banks in partial shade. Very showy.

The same collected without bulb or leaves, by M. Bang at Songo, November, 1890 (*no. 918*). Buchtien's No. 3155, from Cotanya, Ilimani, 2,450 meters, November, 1911 (*no. 3144*), has larger flowers, with shorter pedicels, but is probably the same.

Bomarea petiolata

Lower leaf-surfaces and inflorescence lightly puberulent. Stems elongate, slender, reclining or drooping, strongly sulcate in the dried state. Petioles 1 cm. long, thinly margined, the blades 4 to 7 cm. long, 2 to 3 cm. wide, lance-oblong, the base very abruptly contracted into the petiole, acuminate and acute, the principal nerves 7 to 9, with as many finer intermediate ones. Umbel terminal, compound, 4-branched, in my specimens, the branches 2- to 3-flowered, the bracts lanceolate, 2 cm. long, abruptly contracted into an attenuate point. Branches of the umbel slender, 3 to 5 cm. long, the bractlets similar to the bracts, but much smaller, the pedicels slender, shorter than the flowers, which are nearly 3 cm. long, and 2 cm. broad as pressed, campanulate and lightly curved. Sepals obovate, rose-colored externally and cream-colored within. Petals of about equal length, cream-colored with fine purplish spots, spatulate, the lower third being narrowed into a claw. Filaments puberulent. Ovary very small. Style stout, nearly equaling the perigone, the three recurved stigmas about 2 mm. long.

"A vine, 10 meters long, in cultivated ground." The petioles are more or less twisted, as though affording support to the stem.

Ivon, 800 feet, *Martin Cardenas,* February 19, 1922 (*no. 2071*).

Species near *B. edulis,* but peculiar in its well-developed petioles.

DIOSCOREACEAE

DIOSCOREA OBLONGIFOLIA Rusby, Bull. N. Y. Bot. Gard. **6**: 492.

(Specimen in fruit.) Glabrous, the stems slender, terete, reddish. Petioles 2 cm. or more long, reddish, strongly channeled above and shallowly 2-sulcate beneath. Blades 5 to 7 cm. long, 2.5 to 5 cm. wide, ovate, abruptly very short-pointed and acute, lightly cordate, 7-costate, the lowest pair of ribs very short, the second pair terminating in the margin about midway, the third pair meeting at the summit, all connected by numerous crooked, slender secondaries, the venation prominent beneath. Leaves pale-green, especially beneath, thickish and rigid. Only the lowest branch of one panicle seen. Common peduncle 1 dm. long, slender, reddish. Branch 3 dm. long, pendulous, the rachis very slender, the branchlets 5 to 7 cm. long, somewhat distant, peduncled, the peduncles lightly nodose. Fruits on very short, thick recurved pedicels, about 2 cm. broad and 1 cm. long, subtruncate at both ends, the margin thickened, the wings thin and pale-brown, the veins very numerous, faint.

In copses of the pampas about Lake Rogagua, 1,000 feet, *Martin Cardenas,* November 4, 1921 (*no. 1629*).

Dioscorea ferruginicaulis

Ferruginous throughout, especially the stems, with exceedingly short, dense, somewhat glistening hairs. Stems slender, sulcate, of a bright, light rust-color. Petioles similar, very slender, 5 to 7 cm. long, strongly sulcate, the blades 4 to 7 cm. long, and about as wide, ovate, cordate, with broad shallow sinus, the summit abruptly produced into a short, acute, twisted point; entire, very thin, light-green, slightly ferruginous, pale beneath, slenderly and sharply 11-costate, the lowest two ribs on each side connate near the base, the five central ones conniving at the summit, the others gradually terminating in the margin, all connected by slender nearly straight secondaries and by a fine reticulum of veins. Only the floral leaves are present, the upper ones successively reduced. Racemes several in the axils, mostly sessile, unequal, the longer 1.5 dm. long, slender, rather densely flowered, the bracts thin, lanceolate, acuminate, about 2 mm. long, the bractlets similar or a little smaller, the branchlets 3- or 4-flowered. Flowers sessile, about 2 mm. long, the petals slightly shorter than the sepals, ferruginous with lighter margins, much thickened at the tomentose base, where the filaments are attached. Stamens shorter than the perigone, the anthers small. Small rudimentary 3-lobed ovary present.

Esperanza Falls, 500 feet, *O. E. White,* February, 1922 (*no. 2014*). The same collected by M. Bang (*no. 2577*) and distributed and published as "*D. cymosula* Hemsley."

ZINGIBERACEAE

Renealmia spectabilis

Rachis, peduncles, etc., densely pilose with short, thick, tapering hairs. Leaf (but one seen) 6 dm. long, 8 cm. broad, lanceolate, doubly acuminate, very acute at the summit, thickish, the midrib very strong on both surfaces, the nerves innumerable and very fine. Scape not seen. Rachis stout, angled, rather densely flowered, the peduncles stout, 5 to 8 mm. long, mostly 1-flowered. Bract about 2.5 cm. long and broader. Flower short-stipitate. Ovary small, ellipsoid, densely sericeous-pilose. Calyx two-thirds as long as the bract, the base connate about the corolla-tube, the summit shortly and unequally 3-lobed. Corolla-tube half the length of the calyx, turned almost horizontally, the lobes about 2.5 cm. long, two lanceolate, the third ovate, all obtuse, subhyaline and finely nerved. Labellum about as long as the calyx, broadly obovate and obcordate, strongly complanate, keeled, the keel strongly channeled within and extended at the summit into a large, strongly incurved beak or hood. Lateral staminodia very small, uncinately recurved. Filament opposite the keel, rigid, erect, flattened and complanate, half the length of the petals. Anther large. Style very slender, nearly as long as the petals, the stigma 3-lobed.

Rurrenabaque, 1,000 feet, *Martin Cardenas,* January 24, 1922 (*no. 2039*). "Bracts white, petals yellow with red lines."

Species strongly characterized by its long filament and hooded labellum.

Renealmia Cardenasii

Scurfy-tomentellate, the stem slender. Sheath about 1 dm. long, the petiole slender, about half the length of the sheath. Leaf-blade about 4 dm. long, 8 cm. broad, lance-oblong or oblanceolate, abruptly and acutely short-pointed, thin, pale-green, sparsely and finely scurfy. Scape erect, in fruit reaching a meter in height, slender, leafless, invested by a series of about 5 loose sheaths a little shorter than their internodes, with broadly rounded or subtruncate darker summits. Flowering rachis about a fourth or a third of the total length of the scape, densely or loosely flowered. Bracts widely spreading, about 15 mm. long, broadly oval, subtruncate or obtuse, subhyaline, 5-nerved. Bractlet half the length of the bract, hyaline, truncate, cylindric, open nearly to the base on one side. Flowers immature. Fruit 3 cm. long and half as wide, ellipsoid, about 40-ribbed. Seeds 6 mm. long, including the short stipe, broadly obovoid, irregularly and bluntly angular, brown, lustrous, very finely verrucose.

Rurrenabaque, 1,000 feet, *M. Cardenas,* October 7, 1921 (*no. 844*).

Species near *R. breviscapa* Poepp. & Endl.

Costus rurrenabaqueanus

Sheaths, lower leaf-surfaces, etc., minutely soft-puberulent, the stem stout. Sheaths closely enclosing the stem, about 1 dm. long, the summit evenly and horizontally truncate, the blade attached by a narrow base about 4 or 5 mm. long and wide. Blade (only the uppermost seen), 3 dm. long, 7 cm. wide, oblanceolate, with regularly narrowed base and abruptly acuminate and acute summit, pale-green beneath, deep-green above. Spike short and broad, the thick, broad, many-nerved bracts obtuse. Calyx 3 cm. long, 7 mm. wide, cylindric, thick, rigid, 3-lobed, the lobes short, broad and obtuse. Labellum 7 cm. long and nearly as broad, deeply 3-lobed. Petals and labellum lemon-yellow. Petaloid filament purple-red, more than half the length of the labellum and half as wide as long.

Rurrenabaque, 1,000 feet, *Martin Cardenas,* November 28, 1921 (*no. 1882*).

Costus (?) sinningiaeflorus

Hirsute, the leaf-sheaths, bracts and midribs ferruginous underneath, the stems stoutish, densely leafy to the summit.

Leaves (only the upper ones seen) 2 to 3 dm. long, 6 to 10 cm. wide, regularly or somewhat inequilaterally obovate, the summit abruptly continued into a very acute, straight or oblique point about 2 cm. long. Blades thin and flaccid, ciliate, sparsely pilose on the upper surface, finely many-nerved, the slender nerves sharply prominent on both sides, falcate and connivent at the summit. Spike short and dense, closely sessile, the broad ferruginous bracts closely imbricate, some with slightly foliaceous mucronate summit. Flower 7 cm. long, the oblique mouth nearly 5 cm. broad, the campanulate, somewhat ventricose tube nearly as wide as the mouth, white, the limb brownish below, brilliant-purple above, the lobes nearly 2 cm. long, and broader, with rounded summit. Stamens 2, both with two-celled anthers, one reaching a little above the middle of the flower, the other a little higher and distant from the first, the anthers oblong, with rounded summits and cordate base and ciliate inner margins. The rounded summit of the anther appears to consist of an appendage. Pistil not seen. As we found but one specimen of this strange plant, and this has but one flower, I am unwilling to destroy the latter, which is very beautiful, by dissection. In habit and form of flower, the plant is a perfect *Costus,* but its stamen-characters mark it as a distinct genus, which I can scarcely describe from such scanty material.

Rurrenabaque, 1,000 feet, *M. Cardenas,* November 26, 1921 (*no. 1851*).

Marantaceae

Calathea bracteosa

(Eucalathea.) Glabrous, the stems tall, leafy. Petiole (but one leaf seen) nearly a meter long, stout, the base broadly dilated and complanate to serve as a sheath from which the peduncle emerges. Blade 7 dm. long, 3 dm. wide, oval, with rounded base and summit, thin. Peduncles 2 in the axil of the leaf, between them arising a stout rachis 8 cm. long, bearing at its summit an aphyllous sheath similar to the leaf-sheath, and giving origin to 3 peduncles similar to those below, but shorter, and a continuation of the rachis, (the remainder of which has been broken off). Peduncles flabellately arranged, slender, 1 to 2 dm. long, subtended by coriaceous bracts about half the length of the peduncles. Spikes compressed, 6 to 12 cm. long, about 3 cm. wide, composed of distichous, densely imbricated coriaceous bracts, about 1.5 cm. long and of greater breadth, with broadly rounded or subtruncate summit. Flowers light-purple, sessile in the bracts, subtended by membranaceous keeled bractlets. Ovary oblong, a little wider at the truncate summit, densely setaceous-pilose at the base. Sepals about 1 cm. long, one a little wider, oblong with rounded summit, hyaline, finely very many-nerved. Corolla-tube nearly 3 cm. long, very slender, the rest of the flower 1 cm. long, the corolla-lobes subequal, hyaline, 13- or 15-nerved, broadly oval. Petaloid filaments about two-thirds the length of the petals, a short recurved vermiform appendage on one side. Lip a little longer than the latter, subrotund, entire, very thin. Exserted portion of style broadly margined, complanate, the summit involute, the terminal portion small. Capsule 1 cm. long, the three seeds 6 mm. long, light-brown, lightly and coarsely tuberculate.

San Buena Ventura, 1,000 feet, *M. Cardenas,* November 26, 1921 (*no. 1858*).

Calathea stenostachys

(Eucalathea.) Stems, petioles, etc., pubescent, the leaves minutely scurfy, the floral bracts glabrous. Stems short, leafy, a number of aphyllous sheaths at the base. Petiolar sheaths 1 to 1.5 dm. long, the petioles only 3 to 5 mm. long. Blades 1 to 2 dm. long, 4 to 6 cm. broad, lanceolate, with rounded base and acute summit, very thin, pale-green. Spikes simple or with one branch, the peduncles elongate and very slender, the rachis 2 to 3 dm. long, the spikes compressed, about 1 cm. broad, the bracts distichous, complanate, 1 cm. long, oblanceolate, obtuse, light-brown. Ultimate peduncles 2-flowered, filiform, 7 mm. long, a little longer than the calyx. Flowers sessile, the ovary short, white-tomentose. Sepals rigid, lanceolate, long-acuminate and acute. Corolla-tube about 1 cm. long, very slender, the rest of the flower 7 mm. long. Lip about equaling the petals, spatulate, narrow. Style much shorter than the petals, the summit strongly involute. Fruit not seen.

Bala, 1,000 feet, *H. H. Rusby,* November 28, 1921 (*no. 1866*).

Calathea Whitei

(Microcephalum.) Stemless; lower leaf-surfaces minutely scurfy, the flower sparsely pilose. Petioles half the length of the blades, or less, broad but closely involute; costate, with finer intervening nerves. Blades 1.5 to 2 dm. long, obovate, obtusish, involute in drying, very thin, bright-green above, very pale beneath. Heads closely sessile upon the rhizome, crowded, the bracts about 2.5 cm. long, ovate, acuminate, obtusish or acutish, finely many-nerved. Flower yellow. Calyx nearly 1 cm. long, 1.5 to 2 mm. wide, one sepal slightly broader than the others, lance-linear, acuminate, about 15-nerved, hyaline. Corolla-tube 2 cm. long, very slender, the lobes 1 cm. long, the posterior 3 or 4 mm. broad, nearly twice as wide as the lateral. Petaloid stamen-lobes unequal, the shorter about two-thirds the length of the labellum, which is much shorter than the petals, and spatulate, its broad, rounded summit crispate or denticulate, strongly incurved over the flower. Top of style much thickened, involute. Capsule broadly obovoid, lightly 3-lobed, bearing the persistent sepals, which enclose the base of the stamen-tube and the broadly conic style-base. Seeds 3, nearly as broad as long, truncate, coarsely tuberculate.

Cachuela Esperanza, 500 feet, *O. E. White,* February, 1922 (*no. 1904*).

Calathea Cardenasii

Glabrous, the stem leafy, but one leaf seen. Sheath of petiole about 2 dm. long, closely sheathing, the petiole proper 1.5 cm. long, stout. Blade 1.5 dm. long, suborbicular or broader than long. Culm above the leaf bearing one or more aphyllous sheaths at the base of peduncles which develop later than the terminal one, these sheaths more than 1 dm. long, herbaceous, acute. Peduncles about 2 dm. long, slender, about as long as the spike, which is compressed. Scales imbricate, 2 cm. long, the summit rounded, coriaceous. Ovary 3 or 4 mm. long, cylindric, the upper half narrower, truncate with a setaceous ring at the base of the calyx, which is 4 mm. long, the lobes equal, hyaline, obtusish. Corolla-tube about 12 mm. long, the rest of the flower 5 mm. long. Petals oval, one considerably broader than the others, a little longer than the obovate petaloid stamens, the lateral appendage minute. Lip nearly equaling the petals, very broad, of deeper color. Style very strongly involute; if extended, nearly equaling the lip and longer than the stamen.

In water, on the pampas near Lake Rogagua, 1,000 feet, *M. Cardenas,* November 3, 1921 (*no. 1413*).

PIPERACEAE

Piper benianum Trelease

A shrub (?), scarcely nodose, glabrous, flowering internodes slender and elongated; leaves broadly elliptic or ovate-elliptic, rather abruptly blunt-acuminate, acute at base, rather small (4.5–5.5 × 8–9 cm.), pinnately nerved from about the middle, the nerves 4 or 5 × 2, chartaceous, somewhat glossy and very obscurely granular beneath; petiole 5–15 mm. long, the longer winged; spikes opposite the leaves, as yet young and small (2 × 15 mm.), blunt; peduncle 10 mm. long; bracts small, round-subpeltate, with very narrow concolorous margin; flowers sessile, perfect.

Huachi, head of Beni River, at 3,000 feet, *M. Cardenas*, 1921 (*no. 466*).

Piper bopianum Trelease

A shrub (?), somewhat nodose, flowering internodes slender, moderately elongated, at first subhirsute but glabrescent except near the nodes; leaves obliquely elliptic-lanceolate or oblanceolate, sharp-acuminate, narrowed to the (sometimes cordulate) base, moderate (5 × 15-6 × 14 cm.), pinnately nerved from below about the upper third, the nerves about 6 × 2, drying thin and dull green, dark-punctulate beneath with the nerves hirsute; petiole scarcely 5 mm. long, hirsute, winged; spikes opposite the leaves, thick and short (5 × 10 mm. when flowering), mucronate; peduncle very short (2 mm.), hirsute; bracts round or triangular-subpeltate, with very conspicuous hairy pale border; flowers sessile, perfect; stigmas 3, minute, terminating a slender style as long as the ovary.

Bopi River Valley, at 3,000 feet, *H. H. Rusby*, 1921 (*no. 669*).

Piper Cardenasii Trelease

A shrub, nodose, flowering internodes rather slender but short, villous-hirsute when young; leaves oblong, gradually pointed, cordulate or cordate, moderate (4–5 × 15–16 cm.), pinnately nerved from below the middle, the nerves 6 or 7 × 2, bullulate in age, microscopically scabrous above, appressed-hairy on the nerves beneath; petiole very short (3 mm.), hairy, scarcely winged; spikes opposite the leaves, much curved, as yet young and some 2 × 30–50 mm., rather long-mucronate; peduncle 10 mm. long, crisp-hairy; bracts roundish-subpeltate with narrow margin; flowers sessile, perfect.

Pampas near Lake Rogagua, at 1,000 feet altitude, *M. Cardenas,* 1921 (*no. 1663*), type; also same place, *H. H. Rusby* (*no. 1685*).

Piper cataractarum Trelease

A shrub (?), scarcely nodose, flowering internodes rather slender and elongated, at first softly subvillous; leaves subelliptic, caudate, nearly equilaterally acute at base, moderately large (6.5 × 14–7 × 18 cm.), pinnately nerved from about the middle, the nerves about 6 × 2, drying thin and dark, white-scabrid, the nerves upcurved-hirsute beneath; petiole 15 mm. long, velvety, winged at base; spikes opposite the leaves, as yet young and small (2 × 50–60 mm.), mucronate; peduncle 10 mm. long, somewhat velvety; bracts round-peltate, small with narrow margin; flowers sessile, perfect.

Cataracts of the Bopi River, at 3,000 feet, *H. H. Rusby,* 1921 (*no. 672*).

Piper elliptico-oblongifolium Trelease

A shrub (?), nodose, flowering internodes rather thick and short, loosely hirtellous; leaves obliquely oblong-elliptic, rather abruptly subacuminate, obliquely acute at base, moderate (5 × 12–14 cm.), pinnately nerved from below about the upper third, the looping nerves 5 or 6 × 2 with some fainter intermediates; chartaceous, slightly glossy, granular and with the nerves hirtellous beneath; petiole 15 mm. long, velvety, scarcely winged; spikes opposite the leaves, as yet young and small (2 × 30–40 mm.), mucronate; peduncle scarcely 10 mm. long, hirtellous; bracts rounded-subpeltate, with narrow dingy margin; flowers sessile, perfect.

Bopi River Valley, at 3,000 feet, *H. H. Rusby,* 1921 (*no. 671*). Very like *P. rurrenbaqueanum* except that it is pubescent.

Piper nigro-granulatum Trelease

A shrub (?), scarcely nodose, glabrous, dark-granular throughout; flowering internodes slender but short; leaves lanceolate, acute at both ends or subacuminate, small (8 × 10 cm.), pinnately nerved from below the upper third, the nerves about 5 × 2, drying dull-green and thin, somewhat paler beneath; petiole short (5 mm.), scarcely winged; spikes opposite the leaves, as yet young and small (2 × 20 mm.), scarcely mucronate; peduncle very short (3 mm.); bracts round-subpeltate, comparatively large, conspicuously pale-margined; flowers sessile, perfect.

Bopi River Valley, at 3,000 feet, *H. H. Rusby,* 1921 (*no. 573*).

Piper rectispicum Trelease

A shrub (?), nodose, glabrous, flowering internodes slender and rather short; leaves elliptic, acuminate, acute and sometimes oblique at base, moderate (6 × 15 cm.), pinnately nerved from below the middle, the nerves about 4 × 2, drying rather thin-papery and somewhat glossy beneath; petiole 5 mm. long, scarcely winged; spikes opposite the leaves, straight, 3 × 110 mm., mucronate; peduncle 5–10 mm. long; bracts round- or triangular-subpeltate with narrow pale ciliate border; flowers sessile, perfect; berries subcubic; stigmas 3, minute, sessile.

Bopi River Valley, at 3,000 feet, *H. H. Rusby*, 1921 (*no. 574*).

Piper rogaguanum Trelease

A shrub (?), scarcely nodose, glabrous, flowering internodes slender and elongated; leaves elliptic, gradually acute or subacuminate; cordulate, moderate (6 × 12 cm.), pinnately nerved from below about the middle, the nerves 5 or 6 × 2, drying dull green, somewhat obscurely granular beneath; petiole about 15 mm. long, winged near the base; inflorescence unknown.

Pampas near Lake Rogagua, *H. H. Rusby*, 1921 (*no. 1689*).

Piper rurrenbaqueanum Trelease

A shrub (?), nodose, glabrous, flowering internodes rather thick and short; granular-punctulate; leaves oblong-elliptic, abruptly short-acuminate, obliquely acute at base, moderate (5 × 14 cm.), pinnately nerved from below the upper third, the looping nerves 4–6 × 2 with some intermediates, chartaceous, slightly glossy above, dark-granular beneath; petiole 10–15 mm. long, scarcely winged; spikes opposite the leaves, as yet young and small (2 × 20 mm.), mucronate; peduncle as yet only 5 mm. long; bracts rhombic-subpeltate, the large umbo with very narrow paler margin; flowers sessile, perfect.

Rurrenbaque, at 1,000 feet, *H. H. Rusby*, 1921 (*no. 836*).

Piper svidaefolium Trelease

A shrub (?), scarcely nodose, flowering internodes slender and elongated, green, at first almost canescently crisp-velvety; leaves elliptic- or round-ovate, blunt-subacuminate, rounded at base, 5–6 × 10–12 cm., pinnately nerved from the lower third or half, the nerves about 4 × 2, minutely subscabrid above, the appressed-pubescent nerves pale beneath; petiole 5 mm. long, scarcely winged, crisp-pubescent; spikes opposite the leaves, as yet young and small (2 × 30 mm.), submucronate; peduncle scarcely 5 mm. long, velvety or crisp-pubescent; bracts lunulate-subpeltate with ample pale margin; flowers sessile, perfect.

Pampas near Lake Rogagua, at 1,000 feet, *H. H. Rusby*, 1921 (*no. 1687*).

Peperomia efimbriata Trelease

A fleshy repent-ascending herb; stem slender (1 mm.), drying quadrangular, sparsely hairy below, glabrous above; leaves commonly 3 or 4 at a node, ovate-elliptic or the lowermost orbicular, rounded at both ends or emarginulate, small (5 × 5–7 × 9 mm.), opaque, glossy, at most very obscurely 3-nerved, impressed-punctulate, glabrous or the lower sparsely hairy beneath; petiole 1 mm. long, glabrous; spikes terminal, small (1 × 20 mm.), rather loosely flowered below; peduncle scarcely 10 mm. long, clavate, glabrous; bracts round-peltate.

Pongo de Quime, at 11,500 feet, *O. E. White* (*no. 164*). Type specimen in Trelease herbarium.

Peperomia rurrenabaqueana Trelease

A moderate-sized somewhat forking zig-zag herb, glabrous except for the lower leaf-surface; leaves alternate, lance-elliptic, obliquely narrow-acuminate, rounded at base, moderately large (2.5–3 × 5.5–8 cm.), drying dull and yellowish beneath, obscurely pinnately nerved from below the middle, the branches of the midrib 3 × 2, glabrous above, conspicuously but sparsely long-hairy beneath; petiole rather short (scarcely 10 mm.); spikes terminal and axillary, long and slender (2 × 150 mm.), closely flowered; peduncle short (10 mm.); bracts round-peltate; berries oblong, subtruncately scutulate; stigma oblique.

Rurrenabaque, at 1,000 feet, *H. H. Rusby* (*no. 794*). Type specimen in Trelease herbarium.

Peperomia rhombifolia Trelease

A moderately small glabrous herb; stem rather slender (2–3 mm.), 4-angled near the nodes; leaves alternate or opposite, lanceolate to broadly rhombic, sharply rather long-acuminate, subacute at base, moderate (1.5–3 × 5–6 cm.), 5- or 7-nerved; petiole about 5 mm. long, subdecurrent; spikes terminal and axillary, moderately slender and elongated (scarcely 2 × 50 mm.), rather closely flowered, the flowers separated by anastomosing ridges; peduncle filiform, 10–15 mm. long; bracts round-peltate; ovary ovoid, apiculate; stigma terminal.

Bopi River Valley, at 3,000 feet, *H. H. Rusby* (*no. 581*). Type specimen in Trelease herbarium.

Peperomia Cardenasii Trelease

A moderately small succulent spreading herb, drying grayish-green: stem moderate (2–3), drying very angular, somewhat glossy, at first closely velvety, the hairs later fewer or disappearing; leaves commonly 3 at a node, subrhombic-elliptic, obtuse at both ends or the large end cuneate, rather small (1.5 × 2.5–2 × 5 cm.), rather papery, scarcely sulcately 3- or 5-nerved, dark-granular and for a time loosely velvety beneath; petiole 2–5 mm. long, deeply channeled, at first velvety; inflorescence unknown.

Rurrenabaque, at 1,000 feet, *M. Cardenas* (*no. 1174*). Type specimen in Trelease herbarium.

Peperomia bopiana Trelease

A rather small stoloniferous glabrous herb with ascending branches: leaves commonly 3 or 4 at a node, rhombic-lanceolate, almost truncately obtuse, subacute at base, small (5–8 × 15–25 mm.), more or less revolute, opaque, rather obscurely 3-nerved; petiole very short (1 mm.); spikes terminal, small (about 1 × 30 mm.), closely flowered; peduncle at length 2 cm. long; bracts round-peltate.

Bopi River, at 3,000 feet, *H. H. Rusby* (*nos. 387* and *570*). Type specimen in Trelease herbarium.

Peperomia galiifolia Trelease

A rather small creeping succulent herb with short erect leafy branches: stem velvety when young but glabrescent; leaves 3–6 at a node, spatulate-oblong or subelliptic, obtuse, or obscurely subemarginulate, sessile, minute (3–4 × 7–15 mm.), minutely soft-pubescent above, obscurely pinnately veined by transmitted light; spikes terminal, small (scarcely 1 × 20 mm.), closely flowered; peduncle 7 mm. long, velvety; bracts round-peltate.

Pongo de Quime at 11,500 feet, *O. E. White* (*no. 166*). Type specimens in Trelease herbarium.

Peperomia punctulatissima Trelease

A glabrous black-punctulate assurgent herb; leaves alternate, lance-elliptic to broadly elliptic, equally subobtuse at both ends or the narrow end bluntly subacuminate, moderate (2–2.5 × 4–6 cm.), multiple-nerved, the branches of the midrib 3 × 2 from near the base; petiole 5–10 mm. long; spikes terminal and axillary, filiform (1 × 70 mm.), loosely subverticillately flowered; peduncle very short (5 mm.); bracts round-peltate, black; ovary ovoid; stigma obliquely anterior.

Cataracts of the Bopi River, at 3,000 feet, *H. H. Rusby* (*no. 592*). Type specimen in Trelease herbarium.

Peperomia canaminana Trelease

A moderately small succulent glabrous spreading herb, drying gray-green: stem moderate (2–4 mm.), drying very angular, glossy; leaves 3 or commonly 4 at a node, rhombic-elliptic or obovate, acute or obscurely blunt-acuminate or very obtuse, cuneate, rather small (1.2–1.5 × 2.5–3.5, or 2 × 4–5.5 cm.), coriaceous, sulcately 3- or 5-nerved, more or less revolute, impressed-punctulate above; petiole very short (1–2 mm.), deeply channeled; inflorescence unknown.

Canamina, at 4,000 feet, *O. E. White* (*nos. 282, 513* and *515*). Type specimen in Trelease herbarium.

ARTOCARPACEAE

Pseudolmedia hirtellaefolia

Hirsute with coarse white and glistening or ferruginous spreading or somewhat appressed hairs, some of them glandular. Branchlets mostly slender, erect or ascending, reddish gray, coarsely angled, papillose with the bases of fallen hairs. Stipules about 1 cm. long, mostly equilateral or nearly so, ovate, acute, concave, thickish, densely hirsute. Petioles about 5 mm. long, stout. Blades to 2 dm. by 8 cm., ovate with rounded or blunt and inaequilateral base, the summit very abruptly contracted into an obtuse acumination; entire, thickish and rigid, above glabrous and slightly shining, the midrib and secondaries lightly channeled, the venation very finely and strongly reticulate, beneath more or less pilose, all the venation sharply prominent, the secondaries about 14 to 16 on each side, somewhat decurrent on the midrib, widely spreading, falcate, and the ends sharply upcurved to meet in a strong, sinuate intramarginal line. Pistillate flowers (staminate not seen) subsessile, densely hirsute, subtended by about 10 closely imbricate scales which are about 1 mm. broad, thick and rigid, with rounded summit. Ovary broadly ovoid with rounded summit, densely pilose.

In the Bala Mountains near Rurrenabaque, 1,000 feet, *O. E. White,* October 17, 1921 (*no. 1495*).

"A small tree, 20 to 30 feet high, on rocky hillsides in deep forest in sandy loam. Fruit bright-red, as large as a cherry, sweet and slightly acid, very pleasant and very prolific. Seed black. Much eaten by Indians and better than 1492."

This is one of the fruits locally known as "Nui."

Pseudolmedia alnifolia

More or less pilose throughout, the trichomes various. Branchlets stout, short, terete, flexuous, annulate at the nodes, irregularly clothed with short coarse gray hairs, many of them with glandular heads. Stipules deciduous, about 1 cm. long, 3 or 4 mm. wide, lanceolate, acuminate, inaequilateral, thick, with prominent midrib and marginal nerve, puberulent and ciliate. Petioles none, or very short and stout. Blades to 6 by 12 cm., often relatively broader, varying from ovate to obovate, with rounded or subcordate base and broad summit abruptly contracted into a short, mostly obtuse point, entire, thick and rigid, strongly veined, the upper surface pale-green, somewhat shining, the midrib lightly channeled, the lower surface more or less ferruginous, densely minutely papillose, the midrib more or less hirsute, reddish, like the secondaries, which are 16 to 18 on a side, widely spreading, at first straight, then sharply upcurved and connecting near the margin, connected by numerous slender, sharply prominent tertiaries. Fruit broadly ovoid, 1 to 1.5 cm. broad, tomentose or hirsute, deep-purple, the pulp abundant, agreeable.

In the Bala Mountains, near Rurrenabaque, 1,000 feet, *O. E. White,* October 17, 1921 (*no. 1492*).

"A small tree, spreading 20 to 30 feet, common in deep forest. Indians eat this and other kinds, the fruit yellow-red, sweet and slightly acid, the seed yellow."

Ficus Whitei

(Urostigma.) Glabrous. Branchlets stout, deep reddish-brown, roughly wrinkled. Petioles about 4 cm. long, stout, fleshy and roughly wrinkled in drying, reddish or orange, like the midrib, channeled on the upper surface. Blades nearly 2 dm. long, and 6 cm. broad, oblong with rounded base and slightly mucronate obtusish summit, light yellowish-green, the upper surface minutely papillose. Midrib prominent on both surfaces, finely wrinkled, the secondaries 25 or more on each side, with intermediate finer ones, slender, diverging almost at a right angle and abruptly upcurved near the margin, the finer venation strongly anastomosing. Fruit globose, 2 cm. in diameter, shortly and stoutly peduncled, the peduncle bearing a circle of about 4 subconnate reflexed bracts, forming an involucre about 8 mm. broad, above which the fruit is shortly stipitate. Surface of fruit sparsely and rather obscurely muricate. Terminal opening small, surrounded by 5 small incurved yellowish bracts.

Pistillate Flowers.—Perigone 5- or 6-parted, the segments linear, somewhat wider in the middle portion, exceeding the pistil. Akene brown, shining, obovoid with rounded summit, the style lateral, from above the middle, about the length of the akene, the stigma acute.

Staminate Flower.—Perigone-segments 3, one somewhat broader than the others. Anther broadly oval, not quite reaching the summit of the perigone.

On river playas near Covendo, 2,000 feet, *O. E. White,* August 7, 1891 (*no. 1054*). "A large tree."

Ficus bopiana

(Urostigma.) Glabrous. Branchlets reddish-brown, much-wrinkled and roughened. Stipules nearly 1 cm. long, ovate-acuminate and acute. Petioles to 4 cm. long, red and roughened like the branchlets, deeply channeled above. Blades to 7 cm. long, and 8 cm. broad, oblanceolate, with acutish base and abruptly short-pointed and acute summit, entire, pale-green, thickish, the midrib very stout, prominent beneath, nerved, the slender secondaries about 15 on a side, diverging at a right angle, the outer ends strongly upcurved and looped together near the margin, the venation strongly and prominently anastomosing. Fruits axillary, apparently solitary, shortly peduncled, the subtending bracts not seen, globose, about 1 cm. in diameter, the mouth small, light-brown, its margin not elevated, open. Pistillate flower slenderly stipitate, the perigone 6-parted, the segments linear, as long as the inaequilaterally obovoid ovary, its short and slender style arising on the side near the summit. Bractlets subulate, attenuate. Perianth of the staminate flowers 3-parted.

In the Bopi River Valley, 3,000 feet, *H. H. Rusby,* August 11, 1921 (*no. 591*). The same collected by M. Bang, between Tipuani and Guanai, December 1892 (*no. 1665*), and distributed as "*F. Radula* Willd."

Dr. Gleason, who kindly compared the specimen at Kew, thinks it may be the same as Spruce's 2345, collected at San Gabriel.

Pourouma uvifera

(Only fruiting specimens seen). Glabrous, except as to the leaves and inflorescence, the branchlets short and very stout, sharply annulate and heavily wrinkled in drying, the leaves becoming much larger than those here described. Petiole 2 dm. long, terete, sharply several-sulcate. Leaves digitate, 9- to 11-foliolate, the leaflets distinct or shortly confluent at the base, 1 to 2 dm. long, 2.5 to 4 cm. wide, oblanceolate, abruptly acuminate and acute at the summit, obscurely sinuate at the margin, above very shortly puberulent and slightly rough, and drying brownish, beneath white and closely and softly tomentellate, the secondaries 20 to 25 on each side, slender, shortly decurrent at the base, running straight to the margin at about 45 degrees, lightly and sharply prominent on both sides, more so beneath, connected by innumerable fine tertiaries. Fruiting inflorescence only about half as long as the petioles, the peduncles and branches stout, the former slightly thickened upward and recurved, the young fruits velutinous, very shortly and very stoutly pedicelled and slightly umbilicate at the base, ovoid, tipped by a short and very broad style and a broad depressed-capitate or discoid stigma. Mature fruit glabrous, yellowish-green, about 2 cm. long, sweet and mucilaginous, the pulp clinging tightly to the seed.

Rurrenabaque, 1,000 feet, *H. H. Rusby,* October 1921 (*no. 1599*).

A large tree near the river, the edible fruit known as "Uva del monte" (wild grape) and "Tanaribe." It is said that eating it to excess induces an obstinate and dangerous constipation.

Pourouma subtriloba

(Only fruiting specimen seen.) Shortly soft-tomentose, except the scabrous upper leaf-surfaces, the branchlets dark-ferruginous, striate, very slenderly obliquely annulate at the top of the leaf-scar, which is about as broad as long. Petioles stout, striate, ferruginous, less than half the length of the blades, which in my specimens are from 10 to 20 cm. long, 7 to 15 cm. broad, ovate, the largest somewhat 3-lobed, lightly cordate at the base, acute or acutish, entire or very obscurely sinuate-crenate, thick, deep-green and scabrous above, white and soft-tomentose beneath, the secondaries slender, straightish, at an angle of about 45 degrees, connecting very near the margin with the tertiaries, by several loops, connected by innumerable tertiaries, between which the veins strongly anastomose. Fruiting cyme (but one seen) small and few-fruited, stoutly peduncled, the fruits shortly and stoutly pedicelled, subtended by a rotate, entire, thick calyx-base 6 mm. broad, subglobular, nearly 2 cm. long and broad.

Near Tumapasa, 1,500 feet, *M. Cardenas,* December 10, 1921 (*no. 1990*). "A large forest tree with edible fruit." Very near Hayes, Panama, *no. 860,* which appears to be undescribed.

URTICACEAE

Urera viridisetosa

Stem densely clothed with spreading or slightly retrorse prickles which are 3 to 5 mm. long, linear, green, terminating in a white seta, and with the upper part of their margins minutely white-setose. Stipules connate, 10 to 15 mm. long, ovate, with attenuate summit. Prickles of the petioles and veins of the lower leaf-surfaces reflexed, on successively shorter green bases. Petioles about a third of the length of the blades, which are 1 to 2 dm. long, 5 to 10 cm. broad, ovate, acute, slightly cordate, coarsely dentate, both teeth and sinuses short, triangular, acutish; thin, the upper surface deep-green and irregularly papillose, the lower surface pale or grayish-green, tomentose, finely reticulate. Cymes scattered along the sides of the stem, one or two cm. long. Pistillate flowers prickly, the stigma densely pilose. Fruit 2 mm. long, subglobose. Staminate flowers not seen.

Huachi, 1,800 feet, *O. E. White,* September 4, 1921 (*no. 1010*).

"A shrub, 6 to 8 feet high. Prickles worse than those of Jatropha."

A species collected by Dr. Rose near Huigram, Ecuador, is very similar, but is distinct and undescribed.

Myriocarpa purpurascens

(Only the staminate plant seen.) Entire plant lightly scabrous, especially the lower leaf-surfaces. Branches stout, reddish, striate-wrinkled. Petioles 3 to 12 cm. long, slender, grooved above, the blades 1 to 2 dm. long, 5 to 15 cm. broad, ovate, abruptly very short-acuminate and acute, with broad oblique base, finely sinuately serrate, the teeth obtuse or minutely mucronulate, thin but of firm texture, bright-purple, especially when young, coarsely and shallowly pitted on the upper surface, the venation lightly prominent beneath, the slender secondaries 8 or 10 on a side, at first widely spreading, then strongly falcate, connected by very slender tertiaries, these connected by a coarse reticulation. Stipules nearly 1 cm. long, purple. Spikes branching at the base, very numerous, exceeding the leaves, filiform, densely flowered, the flowers purple. Calyx 2 mm. broad, 4-parted, the divisions slightly unequal, the anthers mostly 4, occasionally 5 (the fifth perfect?).

Along the Bopi River, 3,000 feet, *H. H. Rusby,* September 11, 1921 (*no. 659*). A small tree with purple flowers, in the edge of the forest.

LORANTHACEAE

Phrygilanthus cordifolius

Glabrous, the stems stout, terete, gray, sparsely and minutely black-punctate, the internodes much shorter than the leaves. Leaves sessile, clasping, 5 to 8 cm. long, 3 to 5 cm. wide, obtuse, shallowly cordate, entire, thick, pale-green, the venation lightly prominent, strongly so beneath, 10- to 12-nerved from the base, with abundant, very slender reticulation. Flowers orange-red, densely aggregated at the ends of the stems. Calyx 3 or 4 mm. long, the corolla 3 cm. long, curved before expanding, very slender, the dried petals filiform.

Trinidad, *M. Cardenas,* March, 1922 (*no. 10, special*).

Phrygilanthus falcatus

Glabrous, the stems stout, terete, gray, swollen at the nodes. Leaves opposite, subsessile, 5 to 7.5 cm. long, 2 to 4 cm. broad, lance-ovate, mostly inequilateral, many strongly so and strongly falcately curved, obtuse, entire, moderately thick, about 7-nerved, the nerves extending into the very short petiole, slender, sharply prominent, regular, sparingly branched, the branches mostly erect or strongly ascending. Branches of the raceme opposite, mostly one- or two-flowered, the flowers on very short stout pedicels. Calyx cupulate, 6 to 7 mm. long and about half as broad, thick, finely many-nerved or wrinkled, obscurely and irregularly toothed. Petals 4 or 5 cm. long, needle-shaped or very narrowly linear, exceeding the filiform filaments. Anthers linear, 2 mm. long. Style equaling the petals.

On the River Ibon (eastern Bolivia), about 200 feet altitude, *O. E. White,* February 11, 1922 (*no. 2363*).

"Flowers scarlet-crimson and yellow, the anthers purple."

Var. (?) **macrocalyx**

This form varies from the type in having flowers about a third longer, of a bright yellow color, and with the calyx twice as long. The leaves are more strongly falcate.

On the Rio Ibon, Beni, 200 feet, *O. E. White,* February 11, 1922 (*no. 2399*).

Phoradendron Rusbyanum Trelease

(Quadrangulares.) Pseudodichotomous, the rather long internodes with basal cataphyls only, androgynous. Internodes moderate (2 × 30–40 mm.), smooth, somewhat 4-angled and golden-glistening. Cataphyls a single pair toward the base, blunt and suberect. Leaves subspatulately oblong or obovate, very obtuse, 1 × 3–4 cm., cuneately subsessile. Spikes mostly clustered, short (about 10 mm.), with 2 or 3 slender joints, 6- to 12-flowered in 4 or 4 + 2 series; peduncle 1–3 mm. long. Fruits round-ellipsoid, smooth, 1–1.5 × 2 mm.; sepals closely inflexed.

Reyes, at 1,000 feet, *H. H. Rusby,* (*no. 1714*). Type specimen in Trelease herbarium.

Olacaceae

Heisteria ixiamensis

(Fruiting specimen.) Glabrous. Branchlets elongate, slender, terete, leafy. Petioles to 2 cm. long, dark-brown, narrowly grooved above. Blades to 18 cm. long, by 8 cm. broad, oblong to oval, with obtuse or acutish base and acute summit, relatively thin, all venation slender, lightly prominent beneath, the secondaries, about 10 on each side, widely spreading, then strongly ascending and connecting at some distance from the margin, connected with one another and with the midrib by numerous straightish and very slender tertiaries. Fruits borne on nodules of the leafy branchlets. Pedicels slender, regularly thickened upward, 1 to 2 cm. long. Calyx 2 to 2.5 cm. broad, strongly veined, the margin obscurely sinuate. Drupe 1 cm. long, 7 mm. broad, oval and nearly elliptic.

Ixiamas, 1,500 feet, *Martin Cardenas,* December 13, 1921 (*no. 1906*).

Species near *H. cauliflora* Smith, but well distinguished by its pedicellate fruits.

POLYGONACEAE

Coccolobis padifolia

Glabrous. Branchlets numerous, short and stout, very flexuous, coarsely angled. Sheaths short and broad. Bracts coriaceous, triangular-ovate, broader than long, short-acuminate and acute, erect. Petioles to 1 cm. long, stout, sulcate. Blades to 12 by 4 cm., regularly lanceolate with rounded base and obtuse or acutish summit, entire, thick and coriaceous, the slender venation prominent on both sides, finely and very strongly anastomosing, the secondaries about 8 or 10 on each side, ascending at a little more than 45 degrees, strongly falcate. Racemes terminating short branchlets, the base sheathed with imbricate scales, shortly peduncled and mostly subtended by a miniature leaf; mostly 2 to 3 cm. long, slender, loosely flowered. Pedicels filiform, about 3 mm. long. Sepals 5, imbricate, petaloid, 2 mm. long. Corolla wanting. Stamens equal, the filaments dilated toward the base and slightly connate, the anthers rounded. Styles 3, the stigmas flattened, their margins crenate-lobed. Ovary ovoid, short, the base enclosed in the short stamen-tube.

Rurrenabaque, 1,000 feet, *H. H. Rusby,* October 7, 1921 (*no. 848*).

Triplaris Williamsii

Branchlets stout, flexuous, dark-brown. Ochreae caducous, not seen. Petioles 2 to 2.5 cm. long, very stout, strongly grooved by the very acute, rigid, involute margins. Blades 2 to 5 dm.

long, 6 to 18 cm. broad, oblong, with rounded base and short-acuminate summit, entire, glabrous, thin in consideration of their great size, deep-green on both sides, the midrib narrowly channeled above, very strongly prominent beneath, the 25 to 30 pairs of secondaries slender, sharply prominent beneath, widely spreading, somewhat crooked, slightly falcate, connecting near the margin, connected by a loose, slender reticulation. Panicles much branched, the branches long, stout, densely gray or yellowish tomentose, like the bracts, the flowers gray-pilose. Bracts 2 mm. high and broad, concave or cup-shaped, the concavity facing outward. Sepals about 1.5 cm. long, 2 mm. broad, oblanceolate, obtuse, with a broad base below a contracted portion, the base long-white-pilose. Petals about as long as the base of the sepals, lanceolate, acuminate and acute, glabrous. Ovary two-thirds as long as the petals, the slender distinct purple styles extending slightly beyond the petals. Staminate flowers not seen. Fruiting calyx-tube nearly 1 cm. long and about half as broad, oval, pilose, the sepals nearly 2 cm. long, 6 mm. wide, oblanceolate with rounded summit. Ovary brown, somewhat shining, finely many-nerved, with obtusish angles, a little shorter than the persistent petals, which lie closely appressed in its grooves.

Fruiting specimen: San Buena Ventura, *R. S. Williams*, 1,000 feet, November 14, 1901 (*Williams, 672,* distributed as *T. boliviana* Britton). Flowering specimen: Huachi, 1,800 feet, midway between Meguilla and San Buena Ventura, *O. E. White,* August 14, 1921 (*no. 958*).

Clearly distinct from *T. boliviana,* especially in the form and venation of the leaves.

Triplaris vestita

Densely tomentellate throughout and more or less ferruginous, the branchlets stout, terete, subcostate, the leaves more or less reflexed. Petioles 1 cm. or more long, very broad, involute, the base slightly clasping. Blades 8 to 15 cm. long, 5 to 8 cm. broad, ovate with rounded and slightly unequal base and mostly obtuse summit, entire, light or yellowish-green, thick, the rather stout venation prominent on both sides, the secondaries about 15 to 18 on a side, spreading, sharply up-curved near the margin and connected by many crooked tertiaries. Panicle terminal, the branches short and stout, densely fruited, the entire fruiting inflorescence light-green, except the ferruginous rachis and bracts, the latter deep-brown, enclosing and longer than the pedicels. Fruiting calyx 3 or 4 cm. long, the tube nearly a third of the length and about as broad as long, the limb narrowly oblanceolate with rounded summit, the narrowly linear, acuminate petals reaching the base of the limb and exceeding the short, slender, distinct styles. Nut nearly as broad as long, strongly and sharply winged.

Meguilla, 3,000 feet, *H. H. Rusby,* July, 1921 (*no. 2175*).

Species totally unlike any other in its leaf-form and indumentum.

Triplaris setosa

Profusely setose-hairy, the hairs ferruginous, divergent or even slightly retrorse. Branches slender, terete, densely leafy. Ochreae not seen. Petioles very short and stout. Blades 2 to 3 dm. long, 6 to 10 cm. wide, lanceolate, with cordate subclasping base and acuminate and acute summit, entire, ciliate, thickish, the venation slender, sharply prominent on both sides, the secondaries 30 or more on each side, falcate, ascending, and very lightly connecting near the margin, connected by numerous slender crooked tertiaries. Panicle (but one seen) terminal, small, densely fruited. Fruiting calyx-tube 1.5 cm. long and 1 cm. broad, the entire calyx 5 cm. long, 7 mm. wide, somewhat unequal, narrowly oblanceolate, the basal portion a half broader than the limb. Petals little exceeding the basal portion of the sepals, but exceeding the styles, which are a third as long as the nut and coherent for nearly half their length.

Near Covendo, 2,000 feet, *O. E. White,* August 20, 1921 (*no. 910*).

This species is closely related to *T. hispida* Britton, which has appressed bristles on the midrib and is of very different leaf-form and habit.

Ruprechtia scandens

Stems woody, thick, twining high and widely, fistulous, the branchlets terete, striate, puberulent. Ochreae 3 or 4 mm. long, with oblique truncate summit, appressed-pilose. Petioles about 8 mm. long, stout, mostly twisted, the margins involute. Blades 1 to 2 dm. long, 3 to 5 cm. broad, oblong, with obtuse base and abruptly very short-pointed obtusish summit, rigid, entire, puberulent above, becoming glabrous, with the midrib and 12 to 15 pairs of secondaries impressed, somewhat harsh beneath, the trichomes more persistent, the midrib and secondaries very strong and prominent, connected by a very fine and exceedingly strong reticulation.

Staminate panicles very slenderly branched, gray-puberulent, the branches rather loosely flowered. Flowers 3 together in a campanulate involucre with very shortly and unequally toothed oblique margin and subtended by an ovate acuminate bract. Flowers slenderly pedicelled, the pedicels pilose, about as long as the involucre. Petals and sepals about equal, about 1 mm. long, oval, obtuse. Stamens half the length of the petals.

Pistillate panicles sparingly branched, the branches distant, slender, gray-pubescent, densely flowered, the lower often subtended by reduced leaves, the flowers green, sessile. Outer bract ovate, the inner connate to form a sheath for the base of the flower, densely pilose. Perigone puberulent within and without, the sepals ovate, obtuse, with strong midrib and mostly 6-nerved, in flower about twice the length of the obtuse, much narrower and somewhat thinner petals. Stamens wholly absent. Pistil two-thirds the length of the petals, the nearly sessile stigmas flattened, at length spreading. Fruiting calyx 3 cm. long. Immature fruit glabrous, 6-winged at the base, becoming 3-winged in the upper third by the confluence of the lower wings in pairs, the wings very acute.

Huachi, 1,800 feet, *Rusby and White,* August 18, 1921 (*no. 972*).

AMARANTHACEAE

Gomphrena lutea

Pilose, the slender white hairs mostly appressed, except about the nodes. Stems or simple ascending branches mostly about 8 to 15 cm. long, slender, sulcate, sparsely leafy, the internodes long. Heads terminal, about 1 cm. broad, yellow, closely subtended by a pair of small leaves. Leaves sessile, 1.5 to 2.5 cm. long, 4 to 6 mm. wide, lance-oblong, with narrowed base and acutely mucronate summit, entire, pale-green, minutely punctate against the light, the midrib stout, prominent beneath, the strongly ascending obscure secondaries about 3 on each side. Bracts hyaline with strong green midrib, 2 or 3 mm. long, broadly ovate, acuminate and very acute. Bractlets 5 or 6 mm. long, hyaline below, yellow above, long-acuminate and acute, slightly exceeding the densely long-pilose sessile flower. Sepals narrow, nearly equal, distinct to near the base, long-acuminate and acute, rigid. Stamen-tube a little shorter than the perigone, narrow, narrowed upward, its ligules more than half the length of the oblong anthers, deeply cleft, the branches narrowly linear. Ovary subglobose, brown with a white crown. Style short, conic, about half as long as the 2 subulate obtuse yellow stigmas.

Ixiamas, 1,000 feet, *Martin Cardenas,* December 14, 1921 (*no. 1911*).

PETIVERIACEAE

Microtea scandens

Glabrous, the stems extremely slender, strongly sulcate, green. Petioles slender, 1 to 2 cm. long, often twisted. Blades 5 to 10 cm. long, 2 to 4 cm. broad, lanceolate, acuminate and acute, with the rounded base very abruptly contracted into the petiole, entire, very thin, bright-green, the 12 to 15 slender secondaries starting at almost a right angle with the midrib, becoming falcate toward the end, the venation sparse. Inflorescence very loosely paniculate, the branches filiform, elongate, subtended by very small, lanceolate or linear reduced leaves. Flowers white, loosely and at length distantly racemose, subsessile, 1.5 mm. broad. Fruit 1 mm. broad, globose, sharply tuberculate.

Ixiamas, 800 feet, *M. Cardenas,* December 18, 1921 (*no. 1942*).

BERBERIDACEAE

Berberis edentata

Glabrous, except for a very minute downiness of the branches of the inflorescence. Branches stout, blackish, densely leafy, the leaves in crowded fascicles terminating short, thick, node-like branchlets. Stipules very variable in size, the largest about 7 mm. long, 3 mm. wide, triangular-ovate, carinate or 3-nerved, acute, thick and rigid. Petioles about 5 mm. long, stout, winged by the abruptly contracted leaf-base, the blades about 4 to 5 cm. long, by 1.5 to 2.5 cm. wide, oblong-oval or somewhat oblanceolate, entire, the margin narrowly thickened, yellowish and revolute, the rounded or blunt summit tipped by a very short pungent spine, the texture thick and rigid, the midrib very stout, the venation strongly prominent on both sides, densely anastomosing, the leaf drying of a yellowish-green color. Racemes stoutly peduncled, compound, apparently recurved or drooping. Flowers subsessile, but pedicelled in fruit. Sepals about 6 mm. long, 4 or 5 mm. wide, 3- or 5-nerved, oval. Petals about as long, nearly orbicular, 3-ribbed at base and finely many-nerved. Stamens 9, equal, distinct, shorter than the petals, the filaments stout and fleshy, slightly broader downward, concave or channeled on the inner side, the anthers about half as long as the filaments, with blunt blackish terminal glands. Pistil as long as the stamens, the ovary oval, with a sessile, discoid, thick stigma two thirds as broad as the ovary.

A handsome shrub, 4 to 6 feet high, on sunny banks at Pongo de Quime, 11,500 feet, *O. E. White,* July 12, 1921 (*no. 169*).

Menispermaceae

Cissampelos violaefolia

Pubescent, with the upper leaf-surfaces subglabrous except on the principal veins. Stems slender, terete, densely short-pubescent. Petioles 5 to 8 cm. long, slender, channeled above, the blades 3 to 6 cm. long, 3.5 to 7 cm. broad, subrotund, cordate, the summit subemarginate and minutely apiculate, entire, thickish, rigid, deep-green above, pale beneath, the venation prominent on both sides, especially beneath, strongly and very finely reticulate, 7- to 9-ribbed, the ribs all originating together at the summit of the petiole. Racemes 7 to 10 cm. long, the rachis stoutish, the bracts similar to the leaves, 1 to nearly 2 cm. broad, conspicuously and finely purple-veined, short-petioled. Flowers (only the pistillate seen) in fascicles of 6 to 10, on slender pedicels which are mostly longer than the petioles of the bracts. Calyx persistent, in fruit subrotund, entire, about 7 mm. broad and about twice as broad as the brown tuberculate fruit.

Ixiamas, 800 feet, *M. Cardenas,* December 20, 1921 (*no. 2015*).

Cissampelos ciliata

Stems, petioles, etc., sparsely pilose with long, white, divergent hairs, the leaf-surface sparsely strigose with similar hairs. Stems very slender, strongly 5-sulcate. Petioles 3 to 6 cm. long, strongly grooved on the upper surface, peltately attached about one fourth of the way from the base of the leaf. Blades 5 to 10 cm. long, and about as wide, ovate, with broad, nearly truncate base and obtuse but setose summit, entire, ciliate, thin, pale-green, especially beneath, the venation slender, coarsely reticulate, radiately 10 to 12-nerved, the ultimate branches of the nerves terminating in the margin. Staminate panicles fascicled, 3 or 4 cm. long, the peduncles and branches filiform, the fully expanded flowers about 2 mm. broad, setose with long shining hairs. Pistilate racemes nearly 2 dm. long, including the filiform peduncle, loosely flowered, the bracts very unequal, the largest about 1 cm. broad, subrotund, thin, pale, ciliate, the flowers mostly about 5, short-pedicelled. Fruit brown, 6 or 7 mm. broad, subrotund.

This plant was first collected by Mr. Bang, at Coripata, March 4, 1894 (*no. 2074*) and doubtfully referred to *C. tropaeolifolia* DC. It was collected twice on the Mulford Exploration: Rurrenabaque, 1,000 feet, *M. Cardenas,* November 24, 1921 (*no. 1797*) and at the same place, *H. H. Rusby,* October 6, 1921 (*no. 811*). All these specimens perfectly maintain the specific characters.

Abuta boliviana

Scabrescent and more or less grayish throughout, the branches stout, terete, striate. Petioles 6 or 7 cm. long, slender, terete, nerved, the blades thick and rigid, 1 to 1.5 dm. long, 7 to 9 cm. wide, ovate, abruptly very short-pointed and acute, with truncate or subcordate base, entire, above pale-green and lightly scabrescent, with the principal veins impressed, beneath gray and harsh, with the stout venation prominent, 5-nerved, the lowest pair of nerves much weaker, connecting with the others by a series of strong loops near the margin, all connected by a loose and stout reticulation. Panicles axillary, branched from the base, very loose, the branches slender, the flowers sessile, or on very short and thick pedicels. Only staminate flower seen. Sepals 3-seriate, the outer very small, subconnate, the inner about twice as large as the second series, which are slightly fimbriate or ciliate. Stamens 6, equal and similar, all distinct, erect, the filament stout, slightly enlarged upward, the anthers broader than long.

Rurrenabaque, 1,000 feet, *O. E. White,* November 25, 1921 (*no. 1812*).

Somphoxylon (?) sp.

Glabrous or the inflorescence sparsely and minutely puberulent. Stems stout, of spongy texture, much wrinkled in drying, the branchlets slender, sharply nerved or angled. Petioles to 2 dm. or more long, very stout, strongly costate or angled. Blades to 2.5 dm. long, mostly a little longer than the petioles but sometimes shorter, ovate, nearly as broad as long, entire, truncate or slightly cordate at the base, cuspidate, the cusp about 10 to 12 mm. long, obtusish; coriaceous, slightly lustrous above, strongly 3-ribbed, with a pair of smaller ribs below, about 3 principal secondaries on each side of the midrib, the venation slender, loosely reticulate, sharply prominent underneath, less so above. Panicles very large, diffusely and loosely branched, the very small flowers loosely racemed on the ultimate branchlets, subtended by rigid, acute, subulate, falcate bractlets, which are longer than the very short pedicels.

Staminate flowers nearly 1 mm. long, the bud obovoid, obtuse. Sepals apparently 3, distinct, ovate, obtuse, longer than the petals. Petals six, the outer about twice as large as the inner, ovate with narrowed base, the inner narrower. Stamens united about two thirds of their length.

Rurrenabaque, 1,000 feet, *H. H. Rusby,* October 19, 1921 (*no. 1289*).

Pistillate plant collected in fruit at the same locality, October 6, 1921 (*no. 796*). The leaves are less coriaceous, more cordate and less cuspidate. The panicle is small and long and slenderly peduncled, the fruits sessile. Fruits oval, 1.5 cm. long, 1 cm. broad, slightly inaequilateral, the style-scar terminal. Putamen finely verrucose, flattened on one side, lightly ridged on the back, the inside of the flattened side bearing a large hollow cylindraceous ridge which fits into the deep concavity of the flattened side of the seed.

I have little doubt that this plant pertains to an undescribed genus. It has the habit and general appearance of *Anomospermum,* but the floral structure excludes it from that genus. Its structure most nearly approaches that of *Somphoxylon,* but is apparently distinct therefrom. The flowers are not in good condition for study, and I have found it impossible to determine the minuter details.

Annonaceae

Porcelia Saffordiana

Twigs glabrous or minutely and closely puberulent, the flowers grayish-tomentellate. Branchlets slender, enlarging greatly in the fruiting stage. Petioles 5 to 10 mm. long, rather stout. Blades to 15 cm. long by 5 cm. wide, lanceolate, with rounded,

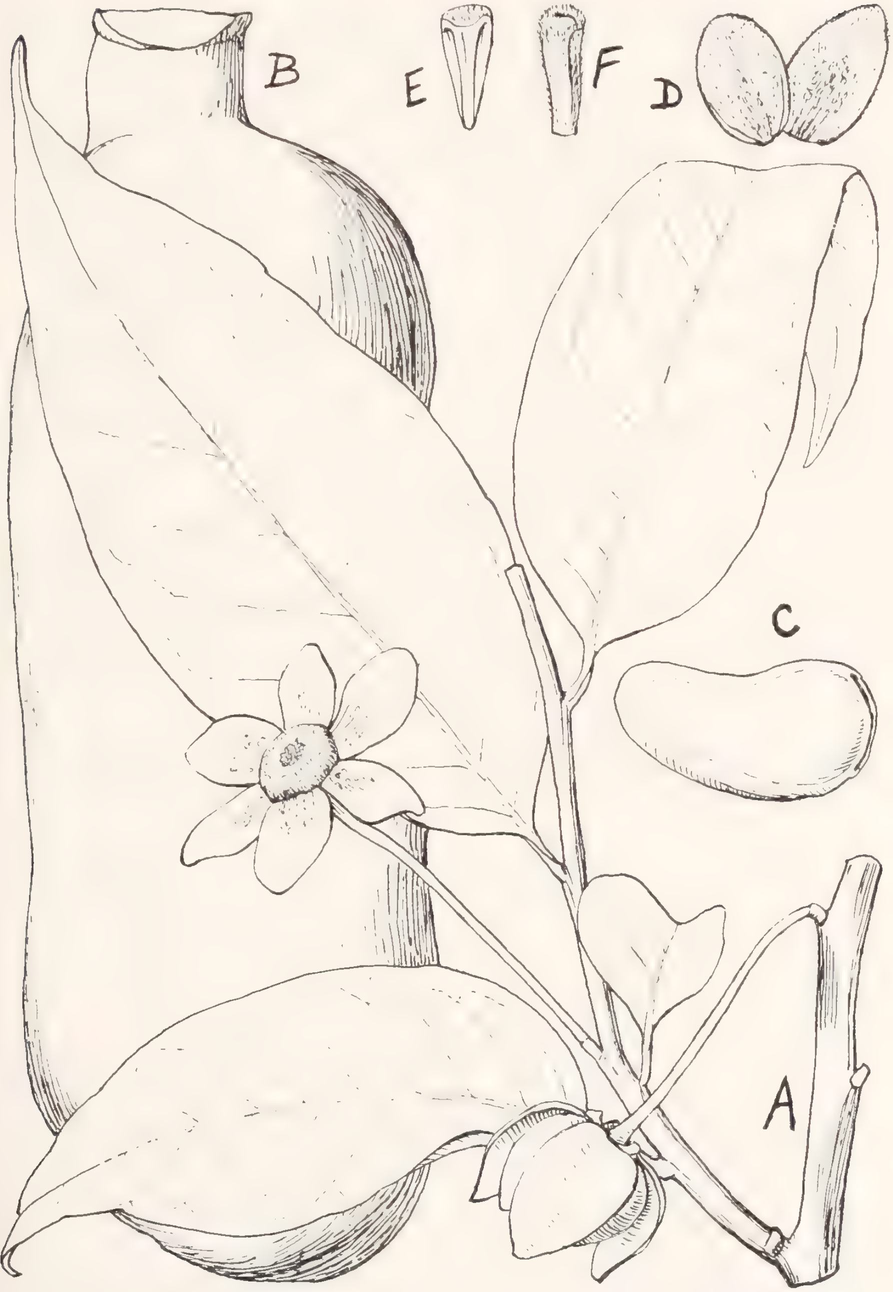


FIGURE 2. *Porcelia Saffordiana* Rusby. A, flowering branchlet; B, immature fruit; C, seed; D, inner (at left) and outer petal, inner faces; E, stamen, × 5; F, pistil, × 5.

often slightly produced base and acuminate and obtusish summit, entire, thick, glabrous, the slender venation lightly prominent beneath, the secondaries about 14 on each side, strongly ascending, connecting at some distance from the margin, the fine venation coarsely anastomosing. Flowers solitary or occasionally two together, the peduncles lateral, 5 cm. long, pendulous, slender, thickened and lightly angled toward the summit, where they are also tuberculate. Flowers deep-purple, the perigone thick and coriaceous, rotate, 4 cm. broad. Sepals 3, ovate, obtuse, 5 mm. long and broad, strongly recurved and the margin revolute. Petals 6, nearly equal, the inner relatively broader, elliptic, 2 cm. long, 12 mm. broad, strongly papillose-glandular on the lower half of the inner face, very finely and closely tomentellate on both surfaces, the margins of the inner 3 more or less involute. Stamen-mass convex, 12 mm. broad, obscurely 6-angled in outline, the stamens numerous, densely massed but distinct. Mass of pistils circular, about 7 mm. broad, depressed or slightly elevated, the pistils more than 20, densely massed but distinct, the stigmas ovate, oblique, with a strong central groove. Unripe fruit, said to be about two-thirds grown, on an enormously enlarged peduncle and weighing about 15 pounds, consists of 9 carpels, in three circles, those of the adjacent circles alternating. Stipes of the carpels 2.5 cm. to 3 cm. long and of equal thickness, the carpels about 15 cm. long and 6 cm. thick, of nearly equal thickness throughout, nearly cylindric, obtuse at both ends, glabrous. Wall of the pericarp about 1 cm. thick, the seeds in two series, embedded in a pulp similar to that of *Asimina,* which this fruit closely resembles. Seed blackish.

The whole of the above description is taken from specimens preserved in formaldehyde, all coming from one large branch brought to me by a native. Other branches brought at the same time and said to come from the same tree, are preserved on a mounted sheet, and differ so greatly that a full description of them is here appended.

The leaves vary from oval, with rounded base and summit, 3 to 7 cm. long by 2 to 4 cm. broad, to lanceolate and 11 cm. long by 4 cm. broad. One detached flower is identical with those above described. Another, that has lost its perigone and many of its outer stamens, appears to be wholly staminate. It is borne on a slender pendulous peduncle 5 cm. long, thickened and tuberculate toward the summit. Its torus is slightly convex and 6 mm. broad, and bears the concave scars where the petals and sepals and many stamens have disarticulated. It still bears about 30 of the central crowded but distinct stamens, which are 2 mm. long, about 0.5 mm. thick, and very slightly narrowed toward the base, prismatic and sulcate and surmounted by a cushion-like puberulent light-brown appendage that is broader than the anther. Another flower, mounted to show a lateral view, has petals only 4 mm. long.

A tree reaching nearly 100 feet in height, and with a trunk-diameter of several feet. The fruit is locally known as "Lucuma," and is highly prized by the natives.

Rurrenabaque, 1,000 feet, November 19, 1921 (*no. 1751*).

Porcelia ponderosa comb. nov.

Guatteria (*?*) *ponderosa* Rusby, Bull. N. Y. Bot. Gard. **6**: 504. 1910.

Guatteria cuspidata

(Fruiting specimen.) Nearly glabrous. Branchlets slender, flexuous, very leafy. Petioles about 5 mm. long, rather stout, blackish, minutely puberulent. Blades to 12 cm. long and 4.5 cm. broad, oblanceolate with obtusish base, the rounded summit very abruptly contracted into a short point; membranaceous, pale-green, the slender venation prominent on both sides, especially beneath, finely and strongly anastomosing, the secondaries about 10 on each side, widely spreading, strongly upcurved at the ends to loop together at some distance from the margin. Carpels few, black, very shortly stipitate, about 1 cm. long and half as wide, ellipsoidal, very minutely puberulent.

Collected at Lake Rogagua, 1,000 feet, *H. H. Rusby,* November 8, 1921 (*no. 1706*).

Guatteria lucida

(Fruiting specimen.) Glabrous. Branches elongate, stout, strongly ascending. Petioles 3 or 4 mm. long and nearly as broad, black. Blades to 2 dm. long and 7 cm. broad, oblanceolate with obtusish base and an extremely abrupt short obtuse point at the summit, entire, thin, shining on both sides, the very slender venation but little prominent, strongly and finely anastomosing, the secondaries about 13 or 14 on each side, strongly ascending and strongly connecting a short distance from the margin. Flowers 2 or more developing from a black lateral node. Fruiting pedicel 2 to 4 cm. long, upwardly thickened, the torus depressed-globose, nearly 1 cm. broad, the stipes about

2 cm. long, upwardly thickened, black, the carpels about 1.5 cm. long and half as wide, inaequilaterally ellipsoid, or slightly narrower below.

Covendo, 2,000 feet, *O. E. White,* August 26, 1921 (*no. 913*).

Duguetia ibonensis

(Fruiting specimen.) Heavily glandular-dotted. Branchlets elongate, slender, glandular-roughened, like the petioles and midribs of the lower surface. Petioles 7 or 8 mm. long, blackish, swollen at the base. Blades to 13 cm. long, 4.5 cm. broad, oblong, acute at both ends, the summit abruptly contracted into a short acumination or cusp. Blade thickish, smooth and shining above, coarsely punctate with white glands beneath, the midrib sharply prominent. Secondaries 15 or 18 on each side, widely spreading and connecting far from the margin. Torus apparently convex, the carpels 12 mm. long, 9 mm. wide, coherent about half way, the exposed portion blackish, the rest brown, 4- to 6-angled, the summit mostly obtuse. Seed nearly elliptic, 1 cm. long and half as broad, brown, very smooth and shining.

On the River Ibon, 500 feet, *O. E. White,* February 22, 1922 (*no. 2089*). "A tree of 10 to 20 feet, in deep, dark forest, in sandy loam. Fruit scarlet-crimson with black blotch on points. Pulp creamy and sweet. Eaten by natives."

Duguetia sp.

A single specimen of *Duguetia* was collected in fruit, neither leaves nor flowers being secured, which exhibits the following characters.

Branchlets very stout, glabrous. Fruits lateral, solitary, the peduncle 2.5 cm. long, 1 cm. thick, woody, bearing a thick annulus at the summit. Outer circle of 21 filaments densely crowded, woody, 14 mm. long, laterally flattened, the upper half thin and blade-like, acuminate, the lower half bearing 3 keels on the back, two of them marginal, the third dorsal and a continuation of the upper part, the broad base projected downward below the torus and slightly 3-toothed by the ends of the keels. Torus fleshy, hemispheric or higher, 3 cm. or more broad. Carpels, in the dried state, 2 cm. long, 13 cm. broad, 7 mm. thick, obovoid, the broadest portion about two-thirds of the way from base to summit. Lower portion blackish, sharply keeled on both sides and both edges. Upper portion brown, wrinkled, puberulent or pulverulent, bearing the short thick style-base. Pulp thin. Seed 2 cm. long, 8 mm. wide, oblong, blackish. Endosperm in numerous transverse folds.

None of the species described has a fruit approaching this in size, but I do not care to name it without first seeing leaves and flowers.

Locality and date unknown.

Trigynaea Periquino

(Fruiting specimen.) Glabrous. Branchlets slender, terete, reddish-brown. Petioles 7 or 8 mm. long, stout, flattened above. Blades to 2 dm. long, and 8 cm. broad, oblong, somewhat oblique, with oblique acute or obtusish base and very abruptly short-acuminate and acute summit, entire, coriaceous, shining above, with the midrib prominent, the midrib and secondaries prominent beneath, the secondaries 14 to 16 on each side, widely spreading, with the ends upcurved and strongly connecting at some distance from the margin, the fine venation obscure, the leaf minutely and densely pellucid-punctate. Position of flowers not determinable from the specimen. Fruiting peduncle 3 mm. long and thicker than its length. Carpels apparently 3 or 4, on a nearly plane torus, the stipe 2 to 3 cm. long, stout, bearing a thick annulus at the base of the carpel, which is occasionally nearly 5 cm. long, varying from globose to short-ellipsoid, rounded at both ends, glabrous. Seeds in a single series, elliptic, vertically flattened, horizontal, 2 cm. long, 12 mm. broad, papillose, brown.

Esperanza Falls, *O. E. White,* March 12, 1922. "Dark-red, with brown seeds. Very sweet and pleasant. Locally called 'Periquino.' "

LAURACEAE

OCOTEA PSEUDO-COTO Rusby, Bull. Torrey Club **49**: 261. 1922. (*No. 1050*).

NECTANDRA COTO Rusby, Bull. Torrey Club **49**: 260. 1922. (*No. 1048, 1050.*)

ACRODICLIDIUM BENENSE Rusby, Bull. Torrey Club **49**: 262. 1922. (*No. 649.*)

CRASSULACEAE

ECHEVERIA WHITEI Rose, Addisonia **10**: 44. *pl. 344.* 1925.

Cunoniaceae

Weinmannia geometrica

Glabrous, except for the ferruginous chaffy scales clothing the young branchlets. Stems much branched, brown, angled. Leaves 4 to 8 cm. long, 2 to 4 cm. broad, sessile. Leaflets 11 to 21, mostly about 15, thin, deep-green, sessile or subsessile, 8 to 20 mm. long and two thirds as broad, rounded above and with acute or cuneate base, serrate-dentate, about 4 teeth on each side, the teeth and sinuses acute. Wings of the rachis rhomboidal, with cuneate base, about two thirds as wide as their leaves and extending completely from leaflet to leaflet. Flowers not seen. Fruiting racemes peduncled, the fruits mostly 2 or 3 together, the pedicels filiform, 3 or 4 mm. long. Capsules about as long, exclusive of the persistent styles, broadly oval.

Pongo de Quime, 11,500 feet, *O. E. White,* July 12, 1921 (*no. 160*). Species very near *W. fagaroides,* but quite distinct.

Amygdalaceae

Hirtella acuminata

More or less ferruginous-hirsute throughout. Branchlets slender, terete, leafy. Stipules slenderly subulate, green, nearly 1 cm. long, acute. Petioles very short, nearly as broad as long. Blades to 1.5 dm. long, and 4 cm. broad, lanceolate, with blunt base and acuminate and acute summit, entire, thin, deep-green on both sides, pubescent on the midrib above, ferruginous-hirsute on the veins beneath, the midribs and secondaries slender, the latter 12 to 15 on each side, strongly ascending and looped together a short distance from the margin, the venation strongly anastomosing. Panicles terminal and occasionally axillary, short-peduncled, densely short-hirsute with spreading hairs, rather densely flowered, the branches subtended by very small bracts. Pedicels 3 mm. or less long, the buds obovate with rounded summit. Sepals 5 or 6 mm. long, slightly unequal, oval, obtuse, thick, strongly recurved. Petals 4 mm. long and nearly as wide, obovate with rounded summit, thick. Stamens 6, the longest 12 to 15 mm. long, the style a little longer. Drupe, in the dried state, 1.5 cm. long, 1 cm. wide, obovoid with rounded summit.

Species apparently related to *H. lightioides* Rusby, but entirely distinct. Along the cataracts of the Bopi River, 3,000 feet, *H. H. Rusby,* September 11, 1921 (*no. 652*). "A large slender shrub in the edge of the forest. Petals white; stamens blue."

Hirtella stipitadenia

Tomentellate and more or less stipitate-glandular. Stipules deciduous, not seen. Petioles 5 mm. long, and almost equally thick, the base spongy-thickened. Blades to nearly 2 dm. long and a third as wide, oblong or oval, with rounded or subcordate base, short-acuminate and acute or obtusish summit, and entire revolute margin, coriaceous, very rugose, the upper surface slightly shining, nearly glabrous, with the midrib prominent and all the smaller venation strongly impressed, beneath densely rough-hairy, all the venation strongly and sharply prominent and strongly anastomosing, the secondaries 12 to 14 on each side, widely spreading and strongly falcate toward the ends. Racemes more or less panicled at the ends of the stout branchlets, sometimes 3 dm. long, stout, densely short-tomentose, light-ferruginous, loosely flowered. Bracts deciduous, 5 mm. long, narrowly subulate, acute. Pedicels about as long as the bracts, thick, shaggy, bearing a variable number of stipitate glands, often 5 mm. long, the stipes slightly thickened upward, the glands capitate, small. Flowers not present. Sepals persistent at the base of the fruit, 5 mm. long and half as wide, ovate, obtuse. Fruit black, smooth or with a few bristly hairs, 1 cm. long and half as wide, oval, 3-sulcate or 3-lobed, the summit truncate or lightly 3-lobed.

Rurrenabaque, 1,000 feet, *H. H. Rusby,* October 4, 1921 (*no. 768*). A large shrub, the agreeable edible fruit known locally as "Urura." Species very near *H. silicia* Griseb.

Mimosaceae

Inga canaminensis

(Euinga.) Short-tomentose throughout. Branchlets stout, terete, flexuous, ferruginous, like the peduncles, etc. Petioles about 3 cm. long, stout, the rachis about 4 times as long, its internodes mostly 4, the upper successively longer, winged, the breadth 8 to 12 mm., broader at the summit, which is broadly rounded to subtruncate, the glands small, circular, their light-brown rim little elevated. Leaflets usually with petioles nearly as broad as long, the lower slightly smaller than the upper, to 12 cm. long and 3.5 cm. broad, oblong or slightly oblanceolate, with rounded, slightly inequilateral base and short-aristate summit, entire, pale or grayish-green on both sides, the venation lightly impressed above, prominent beneath, the secondaries about 14 on each side, with some short intermediate ones, ascending and lightly curved, connected by very many crooked tertiaries. Racemes axillary and terminal, solitary or two or three together, the angled peduncles nearly twice as long as the very densely flowered rachis. Calyx ferruginous, 5 mm. long, 4 mm. broad, campanulate, the lobes 1.5 mm. long, obtuse, erect. Corolla sericeous, nearly 2 cm. long, infundibular-campanulate, the lobes about 6 mm. long, ovate, obtusish. Stamens 5 to 6 cm. long, adnate to the very base of the calyx, connate for about 1 cm. Ovary very small and apparently sterile in my specimens. Style shorter than the stamens, the stigma capitate, very small.

Canamina, 4,000 feet, *O. E. White,* July 20, 1921 (*no. 436*). "A small tree, with creamy-white flowers. Long pod." Species very near *I. edulis* Mart.

Inga apiculata

(EUINGA.) Tomentose. Branchlets stout, ferruginous, roughened with small whitish lenticels. Stipules not seen. Petioles 1.5 to 2 cm. long, stout, subterete. Leaflets 4 or 5 pairs, the lower successively smaller. Rachis to 1 dm. or more long, the internodes margined, the upper successively wider, the uppermost nearly 1 cm. wide at the summit, narrowing downward, the lowest little more than half as wide, a small circular gland between each pair of leaflets, the rim whitish, the concave center dark. Largest terminal leaflets nearly 2 dm. long and half as wide, oval or obovate with broadly rounded sessile base and an abrupt narrow, tapering and acute summit, entire, thick, bright-green and lightly tomentellate on both sides, slightly shining, especially beneath, where the slender venation is prominent. Secondaries 12 or 14 on each side, ascending at about 45° and lightly curved, connected by numerous crooked tertiaries, the finer venation closely and strongly anastomosing. Panicles terminal, peduncled, the peduncles stout, narrowly winged. Branches of the panicle peduncled, the branches suberect, the upper portion densely flowered, the flowers somewhat sericeous. Calyx 1 cm. long, narrowly campanulate, many-nerved, the obtuse lobes brownish, about a third of the length. Corolla a little more than twice the length of the calyx, infundibular, the mouth spreading, the lobes a fifth of the length, obtuse. Stamens light-brown, about twice the length of the corolla, nearly free, united nearly half way. Ovary 5 mm. long, about twice as thick as the style, which equals the stamens, sinuously curved at the end. Stigma very small.

Espia, 3,500 feet, *O. E. White,* July 25, 1921 (*no. 607*). "Small tree on river bank. Flowers white." Species near *I. chrysotricha* Pittier.

Inga trigyna

(EUINGA.) Densely short-tomentose throughout, with the exception of the upper leaf-surface. Branchlets stout, lightly costate, ferruginous. Stipules not seen. Leaves (only the upper seen) sessile, the stout rachis 2.5 dm. long. Leaflets four pairs, or three pairs by the suppression of those at the sessile base, the lower successively smaller, all sessile, the uppermost 2.5 dm. long, 12 cm. broad, oval, varying to slightly broader above or below the middle, with rounded base and slightly produced obtusish summit, thin in consideration of their size, the upper surface nearly glabrous and somewhat shining, pilose on and near the midrib, the principal veins narrowly impressed, softly ferruginous-tomentose beneath, with all the venation sharply prominent. Secondaries about 20 on a side, with very short intermediates, widely spreading and moderately falcate, strongly looped together close to the thinly revolute margin, strongly connected by crooked tertiaries, the venation strongly anastomosing. Glands circular, very small, nearly concealed in the tomentum. Wings of the rachis complete, rhomboidally obovate, obtuse at both ends, the upper successively longer, the uppermost 9 × 6 cm. Panicle (but one seen) terminal, small, stoutly peduncled, the flowers crowded, closely sessile. Calyx-tube narrowly infundibular, nearly 2 cm. long, about 5 mm. broad, usually slightly contracted at the mouth, about twenty-nerved, the teeth subulate, nerved, attenuate, the longest more than 1 cm. long. Corolla densely white-sericeous, the tube narrowly infundibular, longer than the calyx, the lobes 4 or 5 mm. long, ovate, obtuse. Stamen-tube nearly 1 cm. longer than the corolla, the free portion of the stamens about 2 cm. long. Pistils three, the ovary very slender, 3 mm. long, the styles unequal, the longest nearly equalling the stamens. Fruit not seen.

Rurrenabaque, 1,000 feet, *H. H. Rusby,* October 8, 1921 (*no. 833*).

"A tree in the edge of the forest, with white flowers."

Inga ellipsoidea

(EUINGA.) Densely gray-tomentellate throughout. Branchlets very stout, finely many-costate or nerved. Leaves (only the upper seen) petioled, the petioles very stout, somewhat dilated at the base, about two-fifths as long as the rachis, obscurely angled or costate. Leaflets four pairs, subsessile, the glands of the rachis small, deep, with sharply elevated margins. Upper wings of the rachis complete from node to node, the lower not quite complete at the base, the upper successively broader, linear-oblanceolate, the uppermost 12 mm. wide. Leaflets larger upward, the uppermost 3 dm. long, 1 dm. wide, oval with rounded or subcordate base and abruptly acuminate and acute summit, rather thin, but rigid, the indumentum slightly rough, much denser underneath. Venation slender, slightly prominent above, sharply so beneath, the secondaries about 20 on each side, with shorter intermediates, widely spreading, little curved except at the ends, where they are sharply up-curved to connect with a tertiary of the next one above, connected elsewhere by numerous rather straight tertiaries. Spikes normally axillary, but somewhat crowded at the ends of the branchlets, with the subtending leaves often wanting or replaced by large ovate acute bracts. Peduncles (in the young state, with buds still wholly unopened) 1 dm. long, erect or strongly ascending, stout and rigid, many-nerved, bracted above near the flowers as well as beneath the flowers. Spikes in this young state about 6 cm. long, 2 cm. broad, cylindric, truncate, densely flowered. Bracts 12 mm. long, ovate, acuminate, acute or obtusish, shorter than the calyx, which is coriaceous, the tube narrowly campanulate, 1 cm. long, the lobes 3 mm. long, broadly ovate and obtuse.

Along the Bopi River, 3,000 feet, *H. H. Rusby,* Sept. 11, 1921 (*no. 660*).

Inga radiata

(Section LEPTINGA.) Pubescent throughout and somewhat ferruginous, the branchlets elongate and slender. Leaves sessile or nearly so, 4- or 6-foliolate in my specimens, the rachis 4 to 8 cm. long, about 1 cm. broad, including the wings, which are broadest at the truncate or subcordate summit, and taper gradually to the base, which does not extend quite to the very short petiolules. Leaflets 7 to 15 cm. long, 3.5 to 7 cm. broad, the lower successively smaller, oval-obovate, with blunt, or subcordate base and abruptly acuminate and obtuse summit, entire, thin, bright-green, the venation mostly slightly impressed, and puberulent on the upper surface, thin and lightly prominent on the pubescent lower surface, with the venation loosely anastomosing, the secondaries about 8 to 12 on a side, falcate and obscurely connecting near the margin. Umbels 1 to 3, short-pedunculate or sessile, subspheric, the flowers rather loosely radiating, the pedicels filiform, sharply angled, about 6 mm. long. Calyx-tube about 1.5 or 2 mm. long, narrowly campanulate, the upper portion somewhat contracted, the limb 5-toothed, about half the length of the tube, the linear-subulate teeth with incurved summits. Corolla-tube narrowly infundibular, about 4 mm. long, the limb about half as long, the lobes ovate, erect. Stamen-tube about as long as the corolla-tube, very narrowly infundibular. Free portion of the filaments as long as, or exceeding the rest of the flower and shorter than the styles, the anthers and stigma very small. Fruit not seen.

Spreading over river-banks, on the River Ibon, Beni, 400 feet, *O. E. White,* February 18, 1922 (*no. 2393*). "A low tree, 30 to 40 feet high." Species near *I. myriantha.*

Pithecolobium angustifolium (Rusby)

P. sophorocarpum (?) *angustifolium* Rusby, Mem. Torrey Club 6: 28. 1896

This plant, originally collected by Miguel Bang, near Guanai, in 1892, has been again collected (*no. 1752*), at San Buena Ventura, 1,000 feet, November 22, 1921, by M. Cardenas, who reports it as "a large tree, with red fruits." The latter specimens agree in every respect with those of Mr. Bang, showing that the differences between it and *P. sophorocarpum* Benth. are constant over a wide region. I can no longer doubt its specific distinctiveness. The legume consists of about 10 or 12 joints, which are completely separated by short constricted portions. The joints are verrucose, especially before maturing, and all parts of the fruit are ferruginous-tomentellate.

Pithecolobium dependens

(Section CAULANTHES.) Glabrous, the branchlets slender. Leaves 1-jugate, the pinnae 2-jugate, but one of the lower pairs wanting, the petiolules and petioles 1 to 1.5 cm. long, slender, like the rachis, which is about 3 or 4 cm. long, lightly 2-grooved on the upper surface. Stipules wanting, the glands small. Leaflets sessile, 6 to 15 cm. long, 2 to 6 cm. broad, the odd one much smaller, inequilaterally lance-oblong, acuminate and acute at both ends, entire, thin, pale-green, the venation very slender, lightly prominent on both sides, the secondaries few, very unequal, connected by the loosely anastomosing tertiaries. Spikes loosely flowered and raceme-like, solitary or fascicled from knots upon the trunk and large branches, recurved or pendulous, 2 or 3 dm. long, shortly peduncled, the rachis very slender, the flowers of a beautiful rose pink. Flowers solitary, sessile, with a very small subulate bract. Calyx 1 mm. long, the teeth very short, acute. Corolla 7 or 8 mm. long, the tube 1 mm. thick, slightly longer than the abrupt limb, which is more than twice as broad, its lobes erect, triangular-ovate, acute, thickish, each 3-costate. Stamens very numerous, very slender, their exserted portion 2 or 3 times as long as the corolla, united to about the middle, the anthers very small, the base of the filaments adnate to the corolla. Ovary oblong, 1.5 mm. long, the style rather stout.

Bopi River, 3,000 feet, *H. H. Rusby,* August 10, 1921 (*no. 568*). A small tree on the river-bank, clothed with beautiful, rose-pink, pendulous spikes, the flowers covered with ants so small as to be scarcely visible.

Pithecolobium bifoliolum

Glabrous, the branchlets slender. Leaves 1-jugate, each petiolule (in the one leaf seen) bearing but one leaflet, the others being suppressed so as to make the leaf apparently only once pinnate. Petiole 1 cm. long, the petiolule a little shorter, the glands small and obscure. Leaflets subequal, 18 cm. long, 8 cm. wide, inequilaterally ovate, abruptly very short-acuminate and obtuse at the summit, the broad base very abruptly contracted, thin, pale-green, the venation very slender. Spike 4 dm. long, slenderly peduncled, recurved, the rachis very slender, loosely-flowered, recurved, the flowers minutely bracted, subsessile. Calyx 1 mm. long, cupulate or urceolate, the teeth very small, acute. Corolla 10 mm. long, the tube two thirds of the length, the lobes ovate, acute, 3-ribbed. Exserted portion of the very numerous, very slender stamens two or three times the length of the corolla, the filaments connate for about half of their length.

This is possibly a variety of the preceding, to which its habit is very similar. It differs in its broader, solitary leaflets, with shorter petioles, and its longer flowers, the corolla-tube relatively much longer. (*No. 959.*)

Calliandra stricta

Glabrous, the branchlets slender, leafy. Stipules to 6 mm. long, ovate, long-acuminate, pungent, somewhat indurate. Petioles 1 to 2 cm. long, the petiolules a little shorter, both slender, channeled above. Leaves 1-jugate, 2 pairs of sessile leaflets on each pinna, the lower pair very much smaller. Glands obliquely placed at the base of the leaflet, so as to partly face each other, blackish, surrounded by a thickened yellowish ring. Leaflets 10 to 35 mm. long, 3 to 12 mm. wide, lanceolate or oblong, blunt at both ends, with a very slight mucro at the summit, thickish, shining above, subtrinervate, the venation slender, very prominent beneath. Heads fascicled in the axils, successively produced, short-peduncled. Calyx 2 mm. long, cupulate, the teeth very small. Corolla 8 mm. long, the lobes short, triangular-ovate, obtuse. Exserted portion of stamens twice the length of the corolla.

San Buena Ventura, Beni, 1,000 feet, *M. Cardenas,* December 1, 1921 (*no. 1739*). "A small shrub, with red flowers, on the river bank."

Acacia rurrenabaqueana

Closely and densely gray-puberulent. Branchlets slender, strongly sulcate, unarmed. Stipules not seen. Petioles short, stout, flattened above, a large brown gland at or near the first pinnae, the glands of the rachis frequently absent. Pinnae about 8 pairs. Petiole and rachis together about 1 dm. long, the pinnae 5 to 7 cm. long, the lower shorter. Pinnules of the longer pinnae 25 to 30 pairs, sessile, 7 mm. long, 1.5 to 2 mm. wide, the upper side about a fourth of the width of the lower, the base of which is slightly hastate, the summit slightly upcurved, acute and apiculate. Margin thickened. Secondaries stout, about 4, strongly interarching near the margin. Surfaces grayish-green and minutely puberulent. Panicles terminal and in the upper axils, large and compound, the globose heads on slender peduncles shorter than themselves, 1 cm. or less broad, yellow, very dense, the bracts at the base of the pedicel narrowly subulate, acuminate and acute. Calyx campanulate, about two thirds as long as the 5 oblanceolate obtuse petals, lobed half way or more. Petals nearly 2 mm. long. Stamens about 40, nearly distinct, about 5 mm. long. Ovary very small, oblong, the style filiform.

Rurrenabaque, 1,000 feet, *M. Cardenas,* January 25, 1922 (*no. 2043*). "A medium-sized tree, in sandy loam."

Acacia ampeloclada

(Fruiting specimen.) Minutely puberulent. Branchlets slender, reclining or climbing, flexuous, brown, coarsely angled, armed with pairs of divaricate thorns which are about 1 cm. long, stout, the base vertically elongated and the base decurrent, lightly recurved, shining, very pungent. Petioles 1 to 2 cm. long, about a fifth of the length of the leaf, slender, like the rachis and its branches, grooved above. Pinnae about 12 pairs, about 4 or 5 cm. long, the pinnules about 40 pairs on a pinna, sessile, about 4 mm. long, and a fifth as wide, oblong, slightly falcate, truncate at the base, the lower side of which is about 3 times as wide as the upper, the margin ciliate, pale-green on both sides. Fruiting panicle large, much branched, the branches tuberculate or muricate. Pods on a slender, erect-spreading stipe a fifth to a fourth of their own length, about 8 cm. long, nearly 2 cm. wide, oblong, with slightly produced base and very shortly cuspidate summit, strongly flattened, with narrowly thickened margin, glabrous and somewhat shining, the elevated venation coarsely anastomosing, mostly 6-seeded normally, some seeds usually wanting. Seeds in the middle line, about 6 mm. long, obovoid with truncate or depressed summit, brown, shining, on slender funicles.

Espia, 3,000 feet, *H. H. Rusby,* August, 1921 (*no. 284*). A low tree with trunk a foot in diameter, much branched, the ultimate branches becoming long-climbing vines.

Caesalpiniaceae

Bauhinia humilis

Softly tomentellate, the leaves more or less pubescent. Stems slender, the branchlets elongate, terete. Stipules very small, deltoid, acute. Spines about 2 mm. long and nearly as broad at the base, triangular, laterally compressed, acute, light-brown, mostly a little reflexed. Petioles to 2.5 cm. long (or longer?) rather slender. Blades to 8 cm. long in my specimens, with cordate acute sinus and rounded lobes, the divisions nearly 2 cm. broad, divided about two thirds of their length, the sinus acute, the divisions moderately spreading, lanceolate, nearly equilateral, with blunt summit, 5-ribbed, the ribs stout and prominent beneath, the surface nearly glabrous above, tomentellate beneath. Racemes (bearing mature fruit only) terminating the branchlets, elongate, slender, the flowers from the axils of diminutive leaves, the pedicels about 1 cm. long, stout, the calyx persistent, nearly 1.5 cm. long, slender, strongly ribbed. Stipe of the legume nearly twice the length of the calyx, stout. Pod to 15 cm. long, about 1 cm. wide, many-seeded, light-brown, tomentellate, acute or shortly mucronate. Seed nearly circular, 6 or 7 mm. broad.

Reyes, 1,000 feet, *H. H. Rusby,* October 25, 1921 (*no. 1311*). A low and slender shrub.

Bauhinia vulpina

Hirsute throughout except on the upper leaf-surface, with divergent strongly ferruginous hairs. Branchlets short, rather stout, divaricate, coarsely angled. Stipules not seen. Tendrils stout, simple. Petioles 2 to 3 cm. long, slender. Blades 3 to 6 cm. long, 2 to 3.5 cm. wide, cordate with acute or acutish sinus, which is broader than deep. Leaf bifid nearly half way, the sinus open, very acute, aristate; thin, subglabrous on the upper surface, except toward the base, each half 4-nerved, the venation prominent on both surfaces, strongly, finely and crookedly anastomosing. Racemes terminating the branchlets, long-peduncled, the flowering portion dense, conical, about as broad as long, mostly recurved. Bracts nearly 1 cm. long, ovate, acuminate, several-dentate with aristate teeth, membranaceous, strongly veined. Pedicel a little shorter than the calyx. Bractlet linear, about as long as the campanulate calyx-tube, which is brown, strongly 15-nerved, contracted at the mouth, where it is pilose internally, the 5 teeth shorter than the tube, equal, green, thin, ovate, acute, 1- or 3-nerved. Petals about 8 mm. long, ovate, obtusish, thick, strongly veined, pilose externally and at the base internally, the stout claw about a third the length of the limb. Stamens 10, very unequal, much shorter than the petals, the filaments stout and rigid, the anthers ovoid, short and broad. Ovary ovoid, obtuse, densely coarse-pilose. Immature pod 7 cm. long, 2.5 cm. broad, strongly flattened, oblong, apparently 2-seeded, the summit rounded, the margin thickened and hirsute, especially toward the summit, and tipped with the short, thick, hirsute style.

Huachi, 1,800 feet, *O. E. White,* August 14, 1921 (*no. 956*). "A woody climber with pink flowers, in sandy loam in sunny exposures."

CARDENASIA gen. nov.

Calyx-tube extremely short, turbinate, the limb campanulate, inflated before flowering, costate, 5-toothed, the teeth very small and two of them nearly obsolete, imbricate, five of the ribs ex-

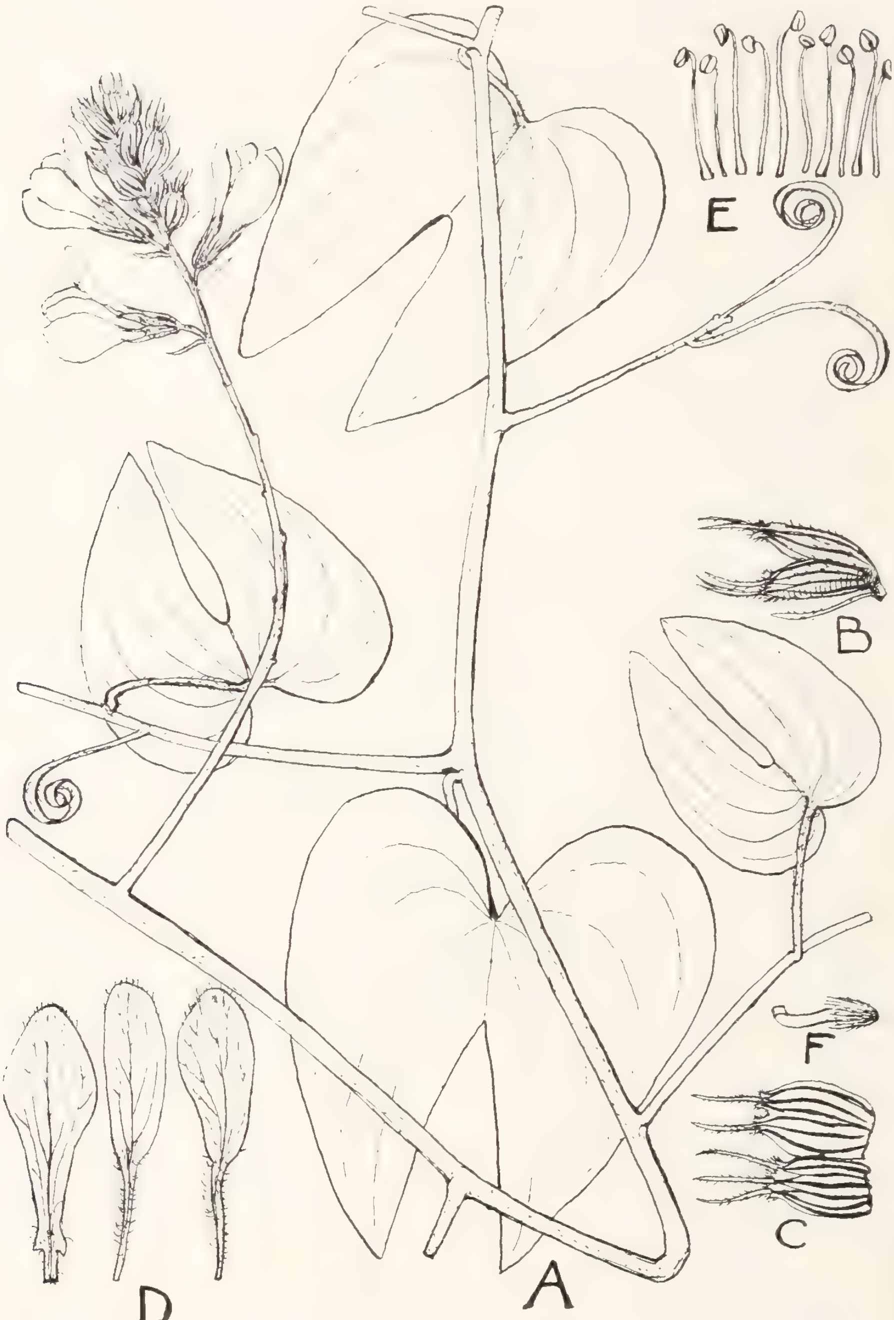


FIGURE 3. *Cardenasia setacea* Rusby. A, leafy branch, with inflorescence and tendrils; B, irregularly fissured calyx, × 2; C, calyx showing five awns, × 2; D, three petals, × 2; E, the stamens, × 3; F, ovary and style, × 2.

tended into setaceous awns, alternating with the teeth, the awns free before as well as after flowering. After flowering, the mouth of the calyx somewhat contracted, but the limb more or less deeply 2-cleft. Petals subequal, unguiculate, pilose. Stamens 10, irregularly subequal, all perfect, nearly distinct, free, five of the filaments slightly dilated at the base, the anthers short, oval. Stipe of the ovary short, adnate to the disk. Ovary oblong, densely pilose, several-ovuled. Style elongate, sigmoid, very thick, the stigma truncate. Fruit not known.

A cirrhiferous climber, of sympodial growth, the pseudo-branches opposite the leaves and terminating in simple racemes, the pedicels setaceous-bracted, the leaves 2-lobed, the stipules caducous. Genus related to *Schnella.*

By those who believe in maintaining the integrity of the genus *Bauhinia,* as treated by Bentham and Taubert, this plant will doubtless be referred to that genus, in spite of its conspicuous long awns. I can not doubt, however, that the genus *Bauhinia* will in the future be resolved into a number of genera. If so, this must certainly be held distinct.

Cardenasia setacea

Puberulent on the young branches, etc., the flowers pilose. Stems very slender, angled, unarmed, cirrhiferous, the tendrils occasionally bearing a few flowers. Stipules not seen. Tendrils strongly circinate, flattened, about 1 to 1.5 mm. wide. Petioles to 4 cm. long, very slender, thickened at the summit. Blades to 10 cm. long and about equally wide, strongly cordate with regularly rounded lobes and obtuse sinus, divided three fourths of the way, very thin, glabrous, the slender venation prominent on the upper surface. Divisions of the leaf almost regularly lance-ovate, entire. Racemes terminating the pseudo-branches short and broad, densely flowered. Pedicels about 5 mm. long, very slender, bracted near the summit, the bracts longer than the pedicel, linear or almost filiform, acute. Calyx nearly 1 cm. long, strongly ribbed, the teeth proper very small, five of the ribs extended into setaceous awns, which are subequal and about as long as the tube. Petals nearly 2 cm. long, spatulate, subequal, pilose, especially on the claw, which is nearly as long as the limb, strongly nerved. Stamens 10, perfect, subequal, about as long as the calyx-tube. Ovary densely pilose, the style nearly as thick as the ovary, curved, blunt.

San Buena Ventura, 1,000 feet, *Martin Cardenas,* November, 1921 (*no. 1195*). "A woody climber, with white flowers, growing in the forest."

FABACEAE

Lupinus Guggenheimianus

Sericeous throughout. Stems slender, much branched, the branchlets short, erect, terete, leafy. Stipules very small, subulate, brownish. Petioles 2 to 4 cm. long, slender, abruptly dilated at the base. Leaflets mostly 7, 1.5 to 4 cm. long, 3 to 8 mm. wide, oblanceolate with acute base and obtuse minutely mucronate summit, the mucro acute; entire, strongly sericeous on both surfaces. Flowers not seen, only the empty twisted valves of the legume present, some of them bearing the vestiges of the androecium and the style. Androecium about 1 cm. long, the united portion slightly shorter than the free filaments, which are extremely slender. Legumes in their twisted condition 2 cm. long, light-brown, densely hirsute. Style about 8 mm. long, very slender.

Pongo de Quime, 11,500 feet, on a dry mountain-side, *O. E. White,* July 12, 1921 (*no. 170*). Species dedicated to the Guggenheim Brothers, from whom we received most valuable assistance at a critical time.

Hoita versicolor

Gray-tomentellate, the calyx blackish. Branches stout, terete. Stipules small, subulate from a broad base, acuminate, acute, subcarinate. Petioles slender, to 4 cm. long, the petiolules about 2 mm. long, the rachis about twice their length, all finely black-glandular. Leaflets to 5 cm. long and 2 cm. broad, ovate, short-acuminate, with rounded base, thick, densely glandular and roughish, minutely hairy, the venation impressed above, the secondaries about 8 to 10 on a side, ascending and lightly falcate. Peduncles 4 or 5 times the length of the rachis, which is densely flowered. Bracts caducous, elongate, attenuate. Calyx-tube inequilateral, campanulate, 3 mm. long, the teeth nearly as long, triangular, acuminate and acute, slightly unequal, the entire calyx densely white-glandular. Vexillum about 9 mm. long, 5 mm. wide, the limb nearly orbicular, the summit emarginate, the base rather abruptly contracted into a short broad claw. Auricle of the wing more than half the length of the very slender claw, broadly triangular-acuminate. Auricles of the keel broadly triangular, the base truncate, the claw very slender. Free portion of filaments about one-sixth of the length. Ovary small, oblong.

La Paz, 11,000 feet, *M. Cardenas,* April 29, 1922 (*no. 48, special*). Species very near *H. hirsuta,* but differing in glands and indumentum and in form and relative dimensions of the floral parts. Flowers white, streaked with blue. A shrub 2 meters high.

Hoita hirsuta

Densely pilose with short white divergent hairs. Branches ascending, flexuous, nodose, dark-colored, terete but strongly nerved. Stipules mostly reflexed, 5 to 8 mm. long, regularly acuminate from the base to the acute summit. Petioles 2 to 3 cm. long, slender, the petiolules 3 mm. long, the rachis about 3 times as long. Leaflets 3 to 6 cm. long, 8 to 16 mm. wide, the terminal not much longer than the lateral, all lanceolate with acutish base and long-acuminate and acute summit, entire, thickish, densely and minutely black glandular-dotted on both sides, minutely hairy, the strongly ascending secondaries 8 or more on a side, slender, the venation obscure. Peduncles stout, longer than the rachis, which is densely flowered, the flowers imbricate, nearly sessile. Calyx-tube campanulate, mostly somewhat inaequilateral, about 4 mm. long and 3 mm. broad, 5-ribbed, with about 10 nerves, the subulate acuminate acute teeth about half as long. Vexillum light blue, obovate, 1 cm. long, 4 mm. broad, the base gradually tapering. Wings a little longer than the vexillum and the keel, and of the same color, adnate to the keel almost to the summit. Free portion of keel deep-purple, concave, obtuse, the base short-auriculate, the wings with long linear-attenuate caudae nearly half as long as their claws. Filaments coherent nearly four fifths of their length. Ovary irregularly obovoid, densely glandular-puberulent, the slender style white, slightly thickened and flattened upward.

Pongo de Quime, 11,500 feet, *O. E. White,* July 12, 1921 (*no. 154*).

Parosela pilocarpa

Glabrous, with the exception of the densely long-pilose inflorescence. Stems very slender, the branchlets widely spreading, terete. Leaves nearly sessile, the rachis about 2 cm. long, the leaflets mostly 9, opposite, nearly sessile, 3 to 5 mm. long, 1.5 to 2 mm. wide, oval or slightly obovate, with rounded summit and obtuse base, entire or almost imperceptibly crenulate, thick, pale-green, minutely and rather sparsely black-glandular. Spikes slenderly peduncled, 1 to 2 cm. long and 1 to 1.5 cm. thick, densely flowered. Bracts 5 mm. long, boat-shaped, keeled, sharply acuminate, thin, brown, long white-pilose, bearing a number of longitudinally elongated brown spots. Calyx a little longer than the bract, the tube hemispheric-campanulate, the teeth linear-attenuate, unequal, about twice the length of the tube, long-pilose like the bract. Corolla a half longer than the calyx. Fruit strongly compressed, densely pilose, triangular in outline, bearing the long densely hirsute style.

Espia, 3,500 feet, *O. E. White,* July 25, 1921 (*no. 609*). "1 to 3 feet high, in sunny places in the river-bottom, the flower violet."

Parosela oblongifolia

Puberulent, the stems elongate, slender, little branched, light-reddish-brown. Stipules 4 or 5 mm. long, narrow, attenuate from the base, thin, reddish. Leaves mostly 2.5 cm. long, the petiole about 1/5 of the length, the leaflets 13 to 17, opposite, very shortly petiolulate, each subtended by a gland that is larger than the others on the rachis. Leaflets 5 to 7 mm. long, 1.5 to 3 mm. wide, oblong or slightly oblanceolate, with subrotund base and rounded summit, mucronate, entire, the margin slightly involute in drying, thickish, profusely black-glandular on the lower surface, the venation obscure. Spikes terminating the upper branchlets, dense, at length elongate. Bracts boat-shaped, 5 mm. long, 1.5 mm. wide, as folded, the linear straight beak about 1/3 of the length, this and the keel blue, the body greenish-white. Calyx campanulate, 5 or 6 mm. long, gray-pilose, bearing 8 or 10 strong green ribs, the teeth triangular, acute, slightly longer than the blue limb, which is broadly ovate with rounded outline, and nerved. Keel pilose, hardly longer than the wings, the claw and the limb of the wing of about equal length, the keel shorter than the vexillum. Filaments united more than half way, the anthers large, blue.

Espia, 3,500 feet, *O. E. White,* July 25, 1921 (*no. 608*). "Two to three feet high, the flowers dark indigo-blue."

Cracca benensis

Pubescent throughout, the hairs short and slightly ferruginous. Stems long and slender, more or less decumbent at the base, the branches irregularly sulcate or angled. Stipules setaceous, 2 or 3 mm. long. Petioles very short or wanting, the rachis 5 or 6 cm. long, rather stout, lightly costate or angled, the leaflets mostly 6 or 7 pairs, opposite, subsessile, without stipellae, to 5 cm. long and 12 mm. wide, oblanceolate, the summit rounded, mostly slightly emarginate and minutely apiculate; entire, thickish, pale-green, the venation slender, sharply prominent on both sides, the secondaries 10 to 15 on a side, nearly straight, ascending at a sharp angle. Racemes terminating the branchlets, elongate, loosely flowered, the rachis sharply angled. Bracts about half as long as the pedicels, lance-linear, acuminate and acute. Pedicels about 3 mm. long, slender. Calyx-tube about 2 mm. long, 3 mm. broad, campanulate, about as long as the shortest tooth and two thirds as long as the longest, the teeth triangular-ovate, slenderly acuminate, rigid. Vexillum 12 mm. long, 1 cm. broad, emarginate, the claw 1 or 2 mm long, broad, the base of the limb broadly rounded or subtruncate. Wings almost equaling the vexillum, their claws adnate to that of the keel. Keel shorter than the wings, the broad summit incurved, the stigma exserted. Stamens shorter than the keel, the free portions of the filaments short and slender. Ovary elongate, tapering into the style, hirsute. Style inflexed at a right angle. Legume 4 or 5 cm. long, 4 mm. wide, linear, almost straight, the margins narrowly thickened, the persistent slender, straight style 5 or 6 mm. long. Seeds 10 to 12.

Reyes, 1,000 feet, *H. H. Rusby,* November 13, 1921 (*no. 1727*). Also at the same place (*no. 1731*) "along roadsides in wet places. Flowers blue."

No. 1312, collected in copses in the same region, may prove to be a variety of the same. Its flowers are rose-colored, the vexillum much broader. The plant is much more hairy, with the hairs more spreading. There are only 8 or 10 leaflets. The calyx teeth are larger and broader and the legume is narrower, with smaller seeds.

Meibomia microcarpa

Tomentellate, the slender ascending stems roughish, the lower leaf surfaces softly so, the branchlets more or less angled or costate. Stipules caducous, thin, brownish, shorter than the petioles, subulate, acuminate. Leaves 1-foliolate, the petioles 5 to 7 mm. long, the stipellae minute, linear. Leaflets 3 to 5 cm. long, 1.5 to 2.5 cm. broad, ovate-oblong, with rounded or subcordate base and blunt or rounded and minutely apiculate summit, entire, light-gray-green, softly hairy, especially beneath. Racemes terminal, peduncled, very slender, very laxly flowered, the flowers often two together. Bracts none or caducous, not seen. Pedicels filiform, little spreading, mostly 3 mm. long. Calyx about a third as long as the corolla, the upper and lower sepals about equal in length, the two lower united to about the middle, triangular-acuminate. Standard a little longer than the keel, obovate, the claw almost none. Keel and wing very narrow, twisted at the summit. Stamens connate for about 4/5 of their length. Style more than half as long as the ovary, inflexed so as to point partially downward. Pod 5-jointed, the sinuses intruded almost equally on both sides, the joints broadly oval or suborbicular, 2 to 3 mm. long, the seed central, the margin narrowly thickened.

Reyes, 1,000 feet, *H. H. Rusby,* October 25, 1921 (*no. 1318*).

Meibomia ovalis

Puberulent. Branches slender, erect. Stipules 4 or 5 mm. long, lance-ovate, mostly inaequilateral, obtuse or acutish. Petioles 1 to 1.5 cm. long, the leaflets 3, the lateral petiolules 1 mm. long, the rachis and petiolule of the terminal 5 or 6 mm. long Stipellae of the lateral leaflets a little longer than their petiolules, linear-attenuate, brownish, very thin, those of the terminal leaflet similar and a little longer. Leaflets oblong, or elliptical, the lateral to 4 cm. long and 1.5 cm. broad, the terminal about a half larger in all dimensions; all with rounded base and minutely apiculate summit, the margin very thinly revolute and minutely ciliate, thin; above deep-green and sparsely short-pilose, beneath very pale and sparsely pubescent, the midrib and secondaries lightly prominent beneath, the secondaries 6 to 8 on a side, strongly ascending and connecting near the margin, the venation coarsely anastomosing. Racemes terminal, solitary, long-peduncled, slender, very loosely flowered, the flowers solitary, the bracts subulate, acuminate, acute, about one fifth the length of the pedicel, which is 6 to 10 mm. long, very slender, little spreading. Two lower sepals connate only at the base, ovate, acuminate and acute, more than half as long as the corolla, the upper a little longer. Vexillum 6 mm. long and nearly as wide, the claw short and broad. Wings about 4 mm. long, the keel a little longer. Stamen-tube nearly as long as the wings, coherent almost to the minute anthers. Ovary pubescent, green, a little longer than the wings, strongly incurved. Fruit not seen.

Rurrenabaque, 1,000 feet. *H. H. Rusby,* October 15, 1921 (*no. 1285*).

Meibomia longiarticulata

Roughish-hairy, with rather coarse, divergent hairs. Stems purplish, rather stout, nerved, much-branched, the branchlets rather short, green. Stipules subulate, acuminate, acute, half the length of the petioles, thin, brown, deciduous, the stipellae similar. Leaves trifoliolate, the petiole 5 to 7 mm. long, the rachis nearly as long, the petiolules about half as long. Lateral leaflets 3 to 10 cm. long, 1 to 3.5 cm. wide, lanceolate, with rounded or blunt base and summit, the latter minutely apiculate; thickish and rigid, bright-green on both sides, all the venation slender, the secondaries about 6 or 8 on a side, strongly ascending, the venation loosely but prominently anastomosing. Inflorescence paniculate, the racemes rather densely flowered, the caducous bracts, similar to the stipules, but smaller, the flowers mostly 3 to 5, racemose on a short branchlet. Sepals 1 to 2 mm. long, ovate, obtuse, the two lower wholly connate, the others at the base only. Standard 1 cm. long, 7 to 8 mm. wide, obovate, the base regularly narrowed, without claw. Filaments distinct for about one fourth of their length. Pods (always?) 2 or 3-jointed, the sinuses equally intruded on both sides, the joints to 2 cm. long and 5 mm. wide, oblong, thin, the margin thickened, a slight indentation on one side where the seed is attached.

Covendo, 2,000 feet, *O. E. White,* September 12, 1921 (*no. 1055*).

Amerimnon ovale

Inflorescence, etc., minutely puberulent, the lower leaf-surfaces almost imperceptibly so. Branchlets short, stout, crooked. Stipules and stipellae not seen. Petioles about a fourth of the length of the leaf, mostly erect, stout. Leaflets about 7, alternate, the petiolules 5 mm. long, rather stout, flattened above. Blades to 8 cm. long and a fourth to a third as wide, oblong or oblanceolate with rounded base and slightly produced at the summit into a very short and broad, mostly retuse point, entire, thickish, drying brown, deep-green and shining above, pale beneath, the principal secondaries about 15 on each side, with as many smaller intermediate ones, the venation prominent on both surfaces, more so on the upper surface, the venation extremely finely anastomosing and of a reddish or purple color beneath. Corymbs axillary, puberulent, about 3 cm. long and broad, the peduncle about as long as the flowering portion, very slender. Flower 5 mm. long, the calyx thick, about half the length, campanulate, the lower tooth much larger than the others and about as long as the tube, the others triangular-ovate, obtuse. Petals of the keel straight, oblanceolate, with rounded summit. All petals of nearly equal length. Wings oblong with rounded summit, slightly curved, very abruptly contracted into the very slender stipe, which is slightly more than one fourth the total length. Body of vexillum about as long as that of the wing, but the stipe only half as long as the stipe of the wing, and broader, the limb emarginate, its breadth less than half its length. Stamens unequal, a little shorter than the petals, a little longer than the style, distinct nearly to the base.

Rurrenabaque, 1,000 feet, *H. H. Rusby,* October 19, 1921 (*no. 1292*).

Machaerium foliosum

Glabrous. Branchlets rather stout, densely leafy, coarsely angled or sulcate. Stipules 1 cm. or more long, linear-attenuate, thin, finely nerved. Petiole about one third the length of the rachis, both slender. Stipellae spiniform, 1 or 2 mm. long, slender, pungent. Petioles 2 or 3 mm. long. Leaflets mostly 9 or 11, the lower smaller, from 4 to 8 cm. long, 2 to 3.5 cm. broad, oblong, or slightly obovate, with rounded base and shortly mucronate summit, obscurely dentate with minute, salient teeth, thickish, bright-green, the midrib stout and prominent beneath, the venation very slender and very finely reticulate, the secondaries about 8 on a side, widely spreading, then crookedly falcate. Panicle terminal, sessile, pyramidal, decompound, densely flowered, the inflorescence scurfy-puberulent and somewhat ferruginous. Flowers very short-pedicelled, the bractlets linear-attenuate. Calyx about 3 mm. long, and fully as broad, campanulate, the teeth very short and broad, acutish, the sinuses acute. Vexillum about 1 cm. long and broad, the claw about a fourth of its length, many-veined. Wings a little longer than the vexillum, the claw about a third of the length. Keel about equaling the wings, obtuse, lightly incurved, the claw short, the limb shortly auriculate. Vexillar stamen free. Base of ovary long-acuminate, the style long, strongly incurved. Fruit not seen.

Rurrenabaque, 1,000 feet, *H. H. Rusby,* October, 1921 (*no. 826*). "A large forest tree, with dark-blue flowers."

Machaerium rogaguense

(Fruiting specimens.) Glabrous. Much-branched, the branchlets stout, short, densely leafy, apparently unarmed. Neither stipules nor stipellae seen. Petioles about as long as the rachis. Leaflets 5, the petiolules 2 or 3 mm. long. Blades 4 to 6 cm. long, 2 to 3 cm. wide, ovate, with regularly rounded base and very abruptly short-acuminate and obtuse summit, entire, coriaceous, deep-green, somewhat shining above, the midrib very strong beneath, the principal secondaries 8 or 10 on a side, with intermediates, the venation finely and strongly anastomosing, prominent beneath. Panicles or racemes terminal and in the upper axils, short, densely fruited. Pedicels 2 to 4 cm. long, stout. Persistent calyx about 2 mm. long, campanulate, the teeth short and broad, the stout stipe 7 or 8 mm. long. Legume 5 or 6 cm. long, 1.5 cm. broad, obliquely curved at about one fifth of its length from the base, the widest portion about a half wider than the narrowest, which is at the point of curvature, the margin narrowly and sharply thickened all around; rich-brown in color, puberulent when young, strongly reticulate-veined, the reticulation much finer at the base.

Reyes, 1,000 feet, *H. H. Rusby,* November 12, 1921 (*no. 1716*). A medium-sized tree of the pampas. Also collected as a shrub on the margin of Lake Rogagua, October 31, 1921 (*no. 1370*).

Platymiscium fragrans

(Fruiting specimens.) Finely tomentellate, the leaves minutely puberulent beneath. Branchlets slender, terete, leafy, roughened with elevated lenticels. Stipules and stipellae not seen. Leaves petiolate, the petiole shorter than the rachis, both slender, terete, the leaflets mostly 7 or 9, opposite. Petiolules 3 or 4 mm. long. Leaflets 4 to 8 cm. long, 2 to 4 cm. wide, oblong-ovate, with regularly rounded base and acute, short-aristate summit, entire, thin, bright-green, glabrous above, puberulent on the veins beneath, the midrib minutely verrucose, the secondaries 10 to 12 on a side, slender, spreading at about 45 degrees, lightly curved, the venation loosely reticulate. Racemes axillary, peduncled, short, bearing few fruits. Pedicels 1 mm. long. Persistent calyx 3 mm. long, campanulate, the triangular-ovate, acute teeth unequal, thick and rigid. Stipe of legume about 5 mm. long. Legume (immature) about 4 cm. long and half as broad, oblong or oval, nearly equilateral, with acute base and minutely apiculate summit, very thin, light-brown, puberulent, strongly reticulate-veined.

Rurrenabaque, 1,000 feet, *M. Cardenas,* January 8, 1922 (*no. 2033*). " A large tree in cultivated ground. In drying, it smells like Coca leaves."

Lonchocarpus pluvialis

(Bolivian Rain-tree.) Finely, closely, and densely gray-tomentellate throughout. Branchlets slender, terete, flexuous. Stipules not seen. Petioles about 4 cm. long, terete, ascending, somewhat shorter than the rachis. Leaflets mostly 7, opposite, the lower much smaller than the upper. Petiolules about 1 cm. long, finely grooved above. Larger blades to 1 dm. long and half as wide, oval or slightly obovate with obtuse, slightly produced base and slightly and acutely mucronate summit, entire, thin, gray-green, the terete midrib prominent beneath, the slender secondaries 12 to 15 on each side, ascending at about 45 degrees, straight except at the up-curved ends, connected by the rather crooked tertiaries. Axillary racemes pendulous, longer than the internodes, subsimple, some of the peduncles bearing 2 or 3 flowers. Racemes of the ample terminal panicles recurved. Bractlets wanting or caducous, not seen. Pedicels about 2 mm. long, articulated into small cupulate bases which persist to make the rachis nodose. Buds unopened and only partially mature, the calyx campanulate, 2 mm. long, and a little broader, shortly 5-toothed, the teeth triangular, somewhat unequal. Corolla bud 5 mm. long, oblong, obtuse. Vexillum about 8 mm. long and equally broad, deeply emarginate, the lobes with rounded summit, the base 2-auricled on each side, the basal auricles less than 1 mm. long, obtuse, the claw about as long and broad. Wings nearly as long as the vexillum, oblong with rounded summit, the auricle similar to that of the vexillum, the claw slender, nearly a third of the total length. Petals of the keel very slightly united above, separate below, a little shorter and wider than the wings, the auricle less obvious, the claw about the same. Stamens 10, monadelphous, unequal, united for two thirds of their length, about equaling the style, the anthers large, oval. Ovary densely pilose, gradually contracted into the long stout stipe, the subulate pilose style about half as long, the stigma cupulate.

On the road from Rurrenabaque to Reyes, *O. E. White,* and *H. H. Rusby,* October 22, 1921 (*no. 1302*).

The specific name is in allusion to the dropping of water, resembling rain, from numerous nests of caterpillars in the forks of the branches, an account of which has appeared in *Tropical Woods.* The species is near *L. boliviensis* Pittier.

Oxalidaceae

Lotoxalis Pseudosepium

Petioles and infloresence very sparsely puberulent, the lower leaf-surfaces grayish with a very minute puberulence. Stems slender, branching, height unknown. Stipules very small, ovate, acute, caducous. Petioles 2 to 3 cm. long, filiform. Leaflets 3, the petiolules about 1 mm. long, the rachis 5 to 8 mm. long, the blades 2 to 2.5 cm. long and about half as wide, oval, obtuse at both ends, entire, very thin, the venation obscure, very slender, the secondaries about 8 on each side. Peduncles filiform, about as long as their petioles, mostly bifid, with 2 or more flowers on each branch, the branches subtended by minute setaceous bracts, the flowers pedicelled. Sepals 2 or 3 mm. long, lanceolate, acuminate, persistent. Corolla violet, twice the length of the calyx. Pod 5 cm. long and two thirds as broad, oval or ovoid, with broad truncate base and subtruncate summit, sharply 5- or 10-nerved, bearing the short filiform styles and stigmas. Seeds brown, oval, nearly as broad as long, obtusely triquetrous, strongly muricate, the warts obtuse, in somewhat obliquely transverse rows.

On the pampas about Lake Rogagua, 1,000 feet, *M. Cardenas,* November 1, 1921 (*no. 1393*).

Ionoxalis canaminensis

Pilose with long fine white spreading hairs, which become sparsely scattered on the scape and inflorescence, and are wanting on the upper leaf-surfaces. Tubers densely massed, ovoid, acute, 3 to 5 mm. long, the intermingled stipules mostly a little more than 1 cm. long, ovate or lance-ovate, acuminate, thin, light-brown, ciliate, bearing 3 or more strong nerves on the back. Leaves all radical, the petioles filiform, 6 to 12 cm. long. Leaflets 3, on petiolules little longer than their thickness, the largest 3 cm. long by nearly 4 cm. wide, oval, emarginate, the base very broad, somewhat rounded; thin, light-green, the venation thin, crooked, sparse, the principal secondaries 2 on each side, the upper pair incurved toward the tip of the notch. Scapes filiform, longer than the leaves, the flowers, 7 in my specimen, on very slender pedicels, which are longer than the flowers and are subtended by very short, broad, thin bracts. Calyx 5 mm. long, closely appressed, and the summit somewhat contracted, the sepals ovate, obtusish, the bright-red glands oblong, small. Corolla about 13 mm. long. Stamens about equaling the calyx, the anthers very small. Dissecting material wanting.

Canamina, 4,000 feet, *O. E. White,* July 20, 1921 (*no. 285*). "Flowers violet; common along irrigating ditches."

Erythroxylaceae

Erythroxylon opacum

(Only fruiting specimens seen.) Glabrous, the branchlets slender, terete, gray, leafy. Stipules 4 mm. long, ovate, acute, thick and rigid, bearing a dorsal awn near the summit, persistent. Petioles stout, shorter than the stipules. Blades 6 to 10 cm. long, 2 to 4 cm. broad, oval, acute at both ends, the summit produced into a short and broad point, the margin thinly revolute; thickish, dull-green, darker above, where the venation is lightly prominent, the principal secondaries 10 or 12 on a side, with shorter ones alternating, interarching at some distance from the margin, the venation loosely anastomosing. Fruiting pedicels about as long as the fruits, subtended by several minute bracts, slender, regularly thickened upward, where they are sharply angled. Calyx persistent, rotate, 3 mm. broad, usually bearing some of the persistent filaments. Sepals ovate, thick, obtusish. Fruit 8 mm. long and half as broad, ellipsoidal, sometimes bearing the persistent styles, which are about as long as the sepals.

Rurrenabaque, 1,000 feet, *O. E. White,* January 5, 1922 (*no. 2327*). "Fruit reddish-green when collected."

Erythroxylon venosum

Glabrous, much branched, the branchlets slender. Stipules 2 to 3 mm. long, subulate, acuminate and acute, thick, erect. Petioles 3 or 4 mm. long, stout, dark-red-brown, the blades 3 to 6 cm. long, 1.5 to 3 cm. wide, oval with acute or acutish base and blunt or obtusish summit, the margin thinly revolute, thick, slightly shining above, the midrib and secondaries slightly prominent beneath, the venation elevated and conspicuously reticulate above, the secondaries 6 or 8 on a side, strongly ascending, crooked, connecting about two thirds of the way from the midrib to the margin. Lateral lines about a third of the way from the midrib to the margin, obscure, wanting in most leaves, very slender, crooked, enclosing an areola which is often of a browner color than the rest of the surface. Flowers few, mostly solitary or 2 together, minutely bracted at the base, spreading or somewhat recurved. Pedicels about 3 mm. long, thickened and sharply angled above. Calyx 2 to 3 mm. wide, the sepals triangulate, acuminate and acute, thick. Petals nearly three times the length of the calyx, ovate, obtuse, the midrib brown, much thickened, and terminating in a thick brown appendage. Petals bearing a basal scale on their inner face which is two thirds the length of the petal, bifid and somewhat pilose. Stamens 10, slightly unequal, connate at the base, the filaments slender, pilose, the anthers globoid. Ovary globoid, a little longer than the united portion of the filaments. Styles 3, filiform, somewhat tapering, longer than the stamens, the stigmas capitate.

Rurrenabaque, 1,000 feet, *H. H. Rusby,* October 7, 1921 (*no. 1564*).

MALPIGHIACEAE

Mascagnia ixiamensis

(Specimens with young and mature fruit.) Young portions and inflorescence gray-puberulent. Leaves (only the upper seen) opposite, glandless, the stipules not apparent. Petioles 1 to 2 cm. long, slender, channeled above, mostly twisted, the blades 3 to 4 cm. long, 3 to 5 cm. wide, ovate, with somewhat rounded base and short-acuminate and acute summit, entire, thin, very short-puberulent beneath, obscurely and sparsely so above, the venation lightly conspicuous beneath, the secondaries about 5 on each side, strongly ascending. Panicle terminal, lax, stoutly peduncled, 2.5 dm. long, 4 dm. broad, the branches opposite, divergent with very small ovate, concave bracts with contracted base. Calyx 8-glandular, densely gray-tomentose like the young wings, the sepals broadly triangular-ovate, mostly obtuse, little, if any, exceeding the oblong glands. Mature fruit subrotund, nearly 2 cm. broad, the wing very thin. Mature wings sparsely pilose, the dorsal only half the width of the lateral, or less, the truncate base, which does not extend below the base of the nutlet, broader than the summit.

Ixiamas, 800 feet, *M. Cardenas,* December 19, 1921 (*no. 1999*).

Mascagnia pachyptera

(Fruiting specimen.) Glabrous, except for the lightly pubescent inflorescence. Stems terete, slender, the leaves opposite, mostly glandless, occasionally one or two obscure glands in the edge of the blade near the base, the stipules not apparent. Petioles 1 to 2 cm. long, slender, narrowly grooved above, the blades 6 to 12 cm. long, 3 to 6 cm. broad, oval or slightly obovate, with obtuse or acute base and abruptly short-pointed and acute summit, entire, thin, the venation very slender, scarcely prominent, the principal secondaries about 5 on each side. Small racemes terminating short branchlets or subaxillary, the rachis nodose, the branches minutely bracted. Calyx 8-glandular, subcoriaceous. Fruit sparsely pilose, the carpels three. Wings coriaceous, the dorsal 1.5 to 2 cm. long, 4 mm. wide, extending equally below and above the nutlet, both ends rounded, the lateral 1.5 cm. long, 1 cm. wide, the base broadly rounded, extending somewhat below the nutlet, the margin sinuate, the summit projected above the nutlet and somewhat outward, the venation not prominent. Nutlet large and thick.

Rurrenabaque, 1,000 feet, *M. Cardenas,* November 24, 1921 (*no. 1163*).

Mascagnia macrophylla

Glabrous, except the minute puberulence of the inflorescence, the stems stout, terete, hollow. Stipules not apparent. Petioles 2.5 cm. to 4 cm. long, very stout, twisted, blackish-brown, narrowly grooved above, bearing a pair of oblong glands near the summit. Blades 2 to 3 dm. long, 1.5 dm. wide, ovate or oval, with rounded base and abruptly short-acuminate and acute summit, entire, thin, bright-green, somewhat shining above, the venation slender, lightly prominent on both sides, the secondaries about 10 on each side, strongly falcate toward the margin, connected by a loose reticulum. Panicles axillary, shorter than the leaves, shortly and stoutly peduncled, their branches opposite, bracteate, mostly subtended by small glands. Pedicels short and stout, 2-bracteolate near the summit, the bractlets gland-like. Calyx 10-glandular, the glands small, basal, subglobular, the sepals fleshy, erect, 2.5 mm. long and broad, with rounded summit. Petals yellow, 5 mm. long and broader, very shortly unguiculate, entire. Stamens 10, monadelphous at the base, erect, short, fleshy, all with anthers, the anthers short and very broad, the connective short, thickened, verrucose. Carpels nearly distinct, pubescent, the styles exceeding the stamens, stout, crooked, the stigma flattened, broad, spreading. Fruit 7 cm. broad, 5 cm. long, very thin, lustrous, pale-green, the wings irregularly and shallowly crenate, the principal nerves about 30 to 35, mostly forking at about two thirds of the way to the margin. Dorsal wing about 5 mm. broad, subsemicircular, extending equally above and below the nutlet.

Flowering specimen: Ixiamas, 800 feet, *M. Cardenas,* December 18, 1921 (*no. 1943*). Fruiting specimen: Rurrenabaque, 1,000 feet, *M. Cardenas,* January 26, 1922 (*no. 2044*).

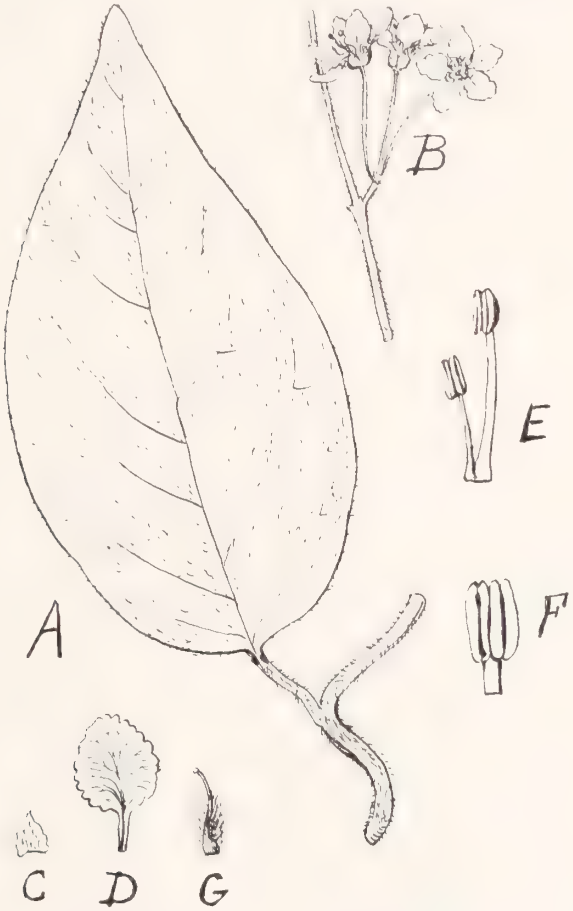


FIGURE 4. *Jubistylis mollis* Rusby. A, leaf, natural size; B, umbel, natural size; C, upper part of sepal, × 2; D, petal, × 2; E, two stamens, × 5; F, anther, × 10; G, pistil, × 2.

JUBISTYLIS gen. nov.

Calyx 5-parted, glandless. Petals unguiculate, glabrous, crenate, the base of the unguis slightly dilated. Stamens 10, all perfect, unequal, the filaments dilated at the base and slightly connate, the anthers ovate, versatile, not appendaged (?), but having a narrow translucent margin. Pistils 3, distinct, pubescent, the lower portion of the style densely long-pilose and ferruginous, the summit recurved, the stigma truncate, small, the ovary apparently without crest or appendages. Fruit not seen.

A climbing plant, with opposite, petioled, mollous foliage, a pair of glands at the summit of the petioles, on the upper side. Flowers yellow, slenderly pedicelled, in lateral, short-peduncled umbels.

Apparently related to *Hiraea,* but differing in its glandular petioles, its distinct pistils, without crests, and its peculiar anthers, which approach *Pterandra* by their thin margin, though scarcely to be called winged.

Jubistylis mollis

Softly, though not very densely pilose, with white hairs. Stems twining, brown, terete or irregularly angled. Branchlets short, slender, leafy, the younger portions pilose with coarse white divaricate or often reflexed hairs. Petioles of the larger leaves 2 cm. long, slender, densely pilose, bearing a pair of blackish glands at the summit, on the upper side. Blades to 1 dm. long and half as wide, ovate with rounded base and shortly acuminate and acutish summit, entire, thin, the upper surface dark-green with a slight gray appearance from a sparse covering of gray hairs, the lower surface densely pilose and gray, the venation slightly prominent beneath, the secondaries about 8 on each side, strongly ascending. Umbels loosely few-flowered, short-peduncled, the pedicels filiform but rigid, about 1.5 cm. long. Sepals 3 mm. long and broad, ovate, obtuse, thin, pilose, glandless. Unguis of petals longer than the sepals, stout, the lamina abrupt, 5 mm. broad and not quite so long, yellow, the margin crenate. Stamens unequal, the longest nearly twice the length of the sepals, the anthers short, ovate, obtuse. Pistils 3, densely and coarsely long-pilose, the styles about as long as the stamens.

Collected along the cataracts of the Bopi River, 3,000 feet, *H. H. Rusby,* September 6, 1921 (*no. 732*). "A large vine in the edge of the forest."

Banisteriopsis Whitei

Grayish-pubescent throughout, the bright-green upper leaf-surfaces sparsely so. Branchlets elongate, slender, terete, sparsely leafy, the leaves opposite, glandular, the stipules not apparent. Petioles 4 to 8 mm. long, very slender, the blades 2 to 4 cm. long and 1 to 2 cm. wide, ovate, with blunt or rounded base and obtuse or acutish summit, entire, thin, softly pubescent beneath and less so above, the venation inconspicuous. Flowers umbellate, or occasionally subracemose, the umbels short-peduncled, mostly 8-flowered, the pedicels filiform, about 1 cm. long, bracted at the base and 2-bracteolate at about the middle, the bractlets very small, herbaceous. Calyx 3 mm. broad, 8-glandular. Petals yellow, 5 mm. long, obovate-spatulate, concave, entire. Stamens much shorter than the petals, unequal, the filaments subulate, connate at the base, the anthers small, whitish or pale, the connective much thickened. Styles slightly exceeding the stamens, the summits flattened, the stigmas cristate. Ovary pilose.

Espia, 3,500 feet, *O. E. White,* July 27, 1921 (*no. 429*).

Banisteria canaminensis

(HETEROPTERYS H. B. K.) Tomentellate throughout, the stems somewhat scabrous, reddish, lightly sulcate. Leaves opposite, only the upper seen, the petioles 5 mm. long, stout, bearing 2 small black glands at the summit, the blades 5 cm. long and half as wide, oval with blunt or rounded base and lightly mucronate summit, entire, thick, subglabrous above, softly tomentellate beneath, where the venation is strongly prominent, the secondaries 4 on each side, strongly falcately ascending, connected by a loose and prominent reticulation. Panicles terminal, large, lax, ferruginous, the flowers crowded at the ends of the branchlets, the bracts small, thick, densely ferruginous. Calyx 2 mm. broad, 10-glandular, two of the glands smaller, the sepals thick, erect, equaling the filaments, oval with rounded summit, lightly denticulate. Petals 3 or 4 mm. long, shortly and stoutly unguiculate, yellow, broadly oval, nearly plane, lightly denticulate. Stamens 10, all with anthers, half the length of the petals, subequal, lightly connate at the base, the anthers lightly recurved, the connective black, dorsally thickened, the thecae white. Ovary pilose, the styles about equalling the stamens, very stout, erect, truncate. A single small fruit seen is apparently immature. The body is not appendaged, and is pilose, the wing 2 cm. long, 5 mm. broad, lightly ascending, the lower half of the inner margin shallowly excavated.

Canamina, 4,000 feet, *O. E. White,* July 21, 1921 (*no. 259*).

Banisteria Bopiana

(HETEROPTERYS H. B. K.) (Fruiting specimen.) Pedicels etc., appressed-pilose, otherwise glabrous. Branchlets stout, leafy, the leaves opposite, glandless, the stipules not apparent.

Petioles 1 to 1.5 cm. long, very stout, strongly channeled above, the larger blades 2 dm. long, 1 dm. wide, oval and obtuse at both ends, entire, coriaceous, the venation slender, prominent beneath, the secondaries about 8 to 10 on a side, ascending, falcate, connected by a coarse reticulation. Racemes axillary, short-peduncled, few-flowered, the pedicels bracted and 2-bracteolate at the base, the bracts short, ovate, thick and coriaceous. Pedicels 1.5 to 2 cm. long, stout, striate, thickened at the summit. Calyx 8-glandular, the glands concave, the sepals triangular-ovate, thick, blackish, hirsute with brown hairs. Body of fruit 1 cm. long and more than half as broad and thick, elliptical. Dorsal wing nearly horizontal, slightly declined, unequally oblanceolate, about 4.5 cm. long, and more than 1.5 cm. broad, auriculate, the auricle about 1 cm. broad and nearly as long, with rounded end, both coriaceous and finely very many-nerved. Crest of the body double, the inner about twice as wide as the outer, both coriaceous and sinuate, and projecting slightly above the body.

In the Bopi River Valley, 3,000 feet, *H. H. Rusby,* September 12, 1921 (*no. 663*).

Banisteria sphaerandra

(HETEROPTERYS H. B. K.) Lower leaf-surfaces and pedicels minutely sericeous-puberulent. Leaves opposite, glandless, the stipules not seen. Petioles about 7 mm. long, narrowly margined, the margins involute, sulcate beneath, like the lower portion of the midrib. Blades 1 to 1.5 dm. long, 2.5 to 4 cm. broad, regularly acuminate and acute, acutish at the base, entire, thick, lustrous above, pale and slightly sericeous beneath, the slender venation not prominent, the principal secondaries 10 or 12 on each side. Panicle large, lax, the branches opposite from a somewhat turgid node, the branches and branchlets subtended by small reduced leaves, the pedicels subtended by ovate, acuminate and acute, green, thick bracts. Pedicels stoutish, about 3 mm. long, the flowers deep-yellow. Calyx 8-glandular, the sepals nearly 3 mm. long, 2 mm. wide, ovate, blunt, thick, green, erect. Petals 7 mm. long, the claw about a fourth of this length, and nearly equally broad, concave, dentate, the teeth short-fimbriate. Filaments subulate, fleshy, monadelphous at the base, unequal, the longest equaling the styles. Anthers 8, reflexed, the oblong greenish thecae borne on the face of a large, subglobular, black, gland-like connective. Ovary black, deeply 3-lobed, lightly pubescent, the styles stout, spreading, truncate. Fruit not seen.

Dr. Gleason says "Bears a strong general resemblance to *B. Mathewsana* (A. Juss.), but in that species the calyx appears glandless."

A single specimen, Yrupana, 5,500 feet, *G. S. McCarty,* August 6, 1921 (*no. 126*).

RUTACEAE

Zanthoxylum Cardenasii

(Only fruiting specimens seen.) Glabrous except a slight puberulence on the pedicels and rachis, the branchlets short and stout. Petiole and leaf-rachis slender, together 7 to 12 cm. long. Leaflets mostly 5 to 7, 6 to 10 cm. long, 2.5 to 4 cm. broad, oblong, with a very abrupt, short, obtuse point at the summit and contracted at the base into a blackish petiolule 5 to 7 cm. long, entire, thick, the secondaries 12 to 15 on a side, slender, widely spreading, lightly interarching near the margin, the midrib stout, terete, strongly prominent beneath, lightly channeled above. Panicles numerous, crowded, short, sessile, densely fruited, the blackish branchlets and pedicels short and thick. Mature carpels mostly 3, sessile by a narrowed blackish base, brown, shallowly pitted, about 5 mm. long and nearly as broad, inequilaterally obovoid with rounded summit tipped by the short and stout style-base. Seed solitary, ellipsoidal, black, smooth and strongly shining, the breadth two thirds of the length, the testa thick.

Ixiamas, 800 feet, *M. Cardenas,* December 17, 1921 (*no. 1933*). A large shrub, with red fruit, on sunny pampas.

Zanthoxylum annulatum

(Fruiting specimens.) Glabrous, the branchlets very stout, terete, gray, finely wrinkled in drying. Petiole and rachis slender, terete, ascending, 10 to 18 cm. long, sparsely and finely black-dotted. Leaflets mostly 5 or 7, thin and membranaceous, bright-green, the lower successively smaller. Petiolules 5 to 10 mm. long, channeled, finely whitish annulate and wrinkled. Blades 8 to 15 cm. long, 4 to 7 cm. wide, oval, acute or short-acuminate at the base, rounded and cuspidate at the summit, the venation very slender, lightly prominent beneath, the secondaries about 12 on a side, widely spreading and lightly and irregularly anastomosing at some distance from the margin, the reticulation obscure. Panicles lateral, sessile, short and dense, the pedicels short and thick, the 2 or 3 carpels subsessile, compressed and lightly keeled, strongly reticulate-pitted, greenish-brown, 6 mm. long, about 3 mm. wide, obovoid with rounded summit. Seed black, somewhat shining, reticulate-wrinkled.

Rurrenabaque, 1,000 feet, *H. H. Rusby,* October 6, 1921 (*no. 795*). A small tree with peculiar and agreeable fragrance.

SIMARUBACEAE

Picramnia monninaefolia

(Fruiting specimen.) Densely and softly pubescent, except the upper leaf-surfaces, which are sparingly pubescent on the principal veins. Branches terete, slender. Leaves 1 to 2 dm. long, the petiole mostly about a sixth or less of the total length. Leaflets mostly 9 or 11, subopposite, the petiolules about 2 mm. long, the blades 3 to 7 cm. long, 1.5 to 3.5 cm. broad, the lower successively smaller, ovate, mostly rounded at the base, especially the lower ones, abruptly short-pointed and acutish, entire, thickish, but herbaceous, the slender venation little prominent on the lower surface, the secondaries about 6 on each side, slightly falcate, connecting at some distance from the margin, the remaining venation obscure. Raceme elongated slender, long-petioled, the pedicels slender, spreading or recurved, about 7 mm. long, slightly thickened upward. Fruiting calyx about 4 mm. broad, 5-parted nearly to the base, the ovate acute lobes widely spreading. Fruit about 1 cm. long and two thirds as wide, ellipsoid, black, glabrous or sparingly pubescent, bearing two short style-bases.

A single specimen probably collected near Canamina, but collection data wanting (*no. 434 A*). Species near *P. Spruceana.*

BURSERACEAE

Icica rhynchophylla

Glabrous, the branchlets slender, lightly sulcate. Petioles 7 cm. or more long, the rachis about twice as long, slender, terete. Leaflets mostly 7, the lowermost about half the size of the uppermost, the slender petiolules about 3 cm. long, the upper portion winged by an involute extension of the blade about 5 mm. long. Blades of the leaflets 10 to 20 cm. long, 4 to 8 cm. broad, oval, obtusish at both ends, bearing a very abrupt narrow appendage about one seventh of the length of the blade, which is entire, thin and dark-green, the slender venation lightly prominent above, sharply so beneath, the secondaries about 12 on each side, widely spreading, the outer ends abruptly up-curved, and connecting near the margin, their branches meeting midway at a broad angle, the venation loosely anastomosing. Spikes loosely paniculately branched, shortly pedunculate, about half the length of their leaves, mostly loosely flowered. Flowers 5-merous, the buds immature in my specimen. Fruit ovoid, 2 cm. long and nearly as broad, slightly concave at the base, acute with the short style-base.

A small forest tree at Rurrenabaque, 1,000 feet. Collected in flower, *H. H. Rusby,* October 8, 1921 (*no. 1592*). The fruiting specimens, which have smaller leaves, were collected under the number *1152.*

MELIACEAE

Guarea membranacea

Glabrous, excepting a very minute puberulence on the flowers. Branchlets very slender, reddish-brown, finely nerved. Petioles to 4 cm. long in my specimen, slender, narrowly grooved, the rachis to 10 cm. Leaflets 1 to 3 pairs, the petiolules 5 to 8 mm. long, the terminal leaflets to 2 dm. long, 7 cm. wide, oval to obovate, very abruptly contracted into a short, obtuse acumination, thin, pale-green, the slender venation slightly prominent beneath, the secondaries 8 or 9 on each side, very slender, widely spreading, lightly falcate at the summit. Lower leaflets similar, but much smaller. Panicles branched from the base or on long slender peduncles, very lax and sparsely flowered. Flowers unopened in my specimen. Mature buds on pedicels 2 mm. long, which are sharply angled, with or without minute bractlets at or above the base. Calyx broadly campanulate, 2 to 3 mm. wide, the margin irregularly and very shallowly lobed, the calyx deep purple-brown, thick, grayish-puberulent. Corolla-bud about 7 mm. long, obovoid with rounded summit. Stamen-tube 6 mm. long, almost equaling the petals, the margin very shallowly 10-crenate. Anthers sessile, 1.5 mm. long, reaching the summit of the tube. Ovary 3 mm. long, nearly cylindric, 5-angled, the stout style a little shorter, the stigma more than 1 mm. broad.

Rurrenabaque, 1,000 feet, *Martin Cardenas,* November 25, 1921 (*no. 1171*). "A large tree in forest, the flowers pure white." Species near *G. Kunthii.*

GUAREA BANGII Rusby, Bull. Torrey Club **49**: 262. 1922. (*Nos. 779, 1590, 2178.*)

GUAREA ALBOROSEA Rusby, Bull. Torrey Club **49**: 263. 1922. (*No. 797.*) This appears to be *G. pendulispica* DC.

Trichilia Cardenasii

Glabrous, but the slender branchlets roughened with minute whitish papillae. Branchlets slender, gray-brown, finely wrinkled. Petioles short, stout, bearing a gland on the upper surface about midway. Leaflets mostly 5, alternate, much larger on the fruiting branchlets than on those in flower, the latter on slender petiolules 5 to 10 mm. long, channeled above. Blades to 6 by 15 cm., oblanceolate to obovate, with acute base, the summit contracted very abruptly into an acute point about 7 mm. long; thickish and rigid, entire, deep-green, drying brownish, the venation very slender, lightly prominent beneath, the secondaries about 18 or 20 on each side, widely spreading, lightly curved, connecting near the margin. Panicles axillary, peduncled, small, loosely branched and loosely flowered, the flowers very small, sessile or on very short stout pedicels. Calyx crateriform, about 2 mm. broad, the sepals ovate with broad obtuse summit, about as broad as long. Petals puberulent, 3.5 mm. long, ovate, obtuse, the summit recurved. Stamen-tube half the length of the petals, its summit bearing 10 setaceous awns about half as long as the tube, the anthers lanceolate, half as long as the tube. Fruit (apparently immature) 8 mm. broad, 6 mm. long, obscurely triquetrous and lightly grooved, with broad summit.

San Buena Ventura, 1,000 feet, *M. Cardenas,* November 26, 1921 (*no. 1856*). "A large forest-tree."

Trichilia pauciflora

Grayish-puberulent. Petioles 5 cm. long, slender, the upper surface plane or shallowly channeled, the rachis 6 or 7 cm. long, the leaflets 5 in all my specimens, subopposite, on petiolules 2 to 5 mm. long. Blades 5 to 15 cm. long, 3 to 9 cm. wide, the lower successively smaller, the terminal much the largest, oval or slightly obovate, with obtusish (the terminal acute) base and very abruptly, shortly and obtusely pointed, entire, thin, pale-green, subglabrous above, puberulent, mostly on the veins, beneath, where the midrib and secondaries are sharply prominent, the latter 10 to 15 on a side, alternate, widely spreading and falcately connecting close to the margin. Panicles (in fruit) axillary, 5 cm. or less long, including the peduncles, densely fruited. Pedicels extremely short. Capsules 1 cm. long, ovoid, tomentose, the three valves stoutly keeled within. Seed solitary, nearly filling the cavity, blackish, smooth and slighty shining, subglobose, enclosed in a thin reddish aril.

San Buena Ventura, 1,000 feet, *Martin Cardenas,* December 1, 1924 (*no. 1743*). "A large tree in the river-margin." So far as my specimens indicate, the species is peculiar in its one-seeded capsules. The species is near *T. viridis* Rusby.

EUPHORBIACEAE

Phyllanthus pseudo-nobilis

(Section CICCA.) (Staminate plant.) Glabrous, the branchlets numerous, short, spreading, floriferous except at the summit, where they bear young developing leaves. Stipules 2 mm. long, narrow, regularly acuminate from the base, thin. Young leaves 2 to 6 cm. long, oblanceolate, shortly acuminate at both ends, minutely cuspidate, tapering into a short petiole, entire, the secondaries 8 to 10 on each side and strongly falcate-ascending, the venation finely anastomosing. Umbels clothing the branchlets, many-flowered, the pedicels densely clothed at the base with minute white scales, filiform, unequal, some nearly 1 cm. long, the fully expanded flowers nearly 2 mm. wide. Sepals 4, oval, blunt, two of them wider, slightly connate at the base. Stamens four, distinct, slightly exceeding the sepals, the filaments stout, the anthers subglobular.

Rurrenabaque, 1,000 feet, *H. H. Rusby,* October 6, 1921 (*no. 793*). Species closely resembling those forms with loose inflorescence which have been referred to *P. nobilis,* but which appear distinct therefrom. This species, however, is distinct, as to both leaves and flowers.

Phyllanthus ibonensis

(Section CICCA.) (Pistillate plant.) Glabrous, the branchlets slender, leafy, thickly covered with small, whitish, elevated lenticels. Petioles 3 to 5 mm. long, stout, blackish, the margins strongly incurved. Blades 5 to 10 mm. long, 2 to 4 cm. wide, sometimes inaequilateral, lanceolate, regularly acuminate and acute, subcordate, entire, thickish, the midrib and secondaries slightly prominent beneath, the secondaries 6 to 8 on a side, strongly falcate-ascending, the venation loosely and lightly reticulate. Racemes several, crowded on reduced nodiform branchlets, unequal, less than 1 cm. long, flexuous, loosely several-flowered, the bracts subulate. Pedicels filiform, 2 or 3 mm. long, slightly thickened upward. Flower 1 to 1.5 mm. long and broad, campanulate. .Sepals 5, somewhat connate at the base, thickish, the summits lightly recurved, oblong, obtuse. Ovary ovoid, shorter than the 3 stout, separate, subulate recurved styles, which slightly exceed the perigone. Fruit (mature ?) 3 mm. long, shortly and broadly ovoid or obovoid, the base loosely invested by the persistent calyx.

On the shore of the Ibon River, 800 feet, *M. Cardenas,* February, 1922 (*no. 2085*). "A small tree with red berries." Species near *P. nobilis,* but differs in the racemose inflorescence, the far more numerous flowers on a flexuous raceme, and with prominent elongate bracts.

Phyllanthus biflorus

Glabrous, the stems erect, very slender, 1 to 3 dm. high, simple or sparingly branched. Petioles very short, the blades 7 to 15 mm. long, 4 to 8 mm. wide, oval, nearly elliptic, some slightly inaequilateral, thickish, entire, the venation slender and inconspicuous, the secondaries mostly 4 on each side. Flowers (always ?) 2 in each axil, one staminate, the other pistillate, the latter with a slightly shorter pedicel.

Staminate flower: Pedicel short, recurved. Perigone 6-parted, the segments subequal, nearly 2 mm. long, narrowly oblong with rounded summit, white with broad green middle band. Stamens 6, about half as long as the perigone, connate for about half their length.

Pistillate flower: Perigone-segments little more than half the size of those of the staminate flower, and relatively broader. Ovary subglobose, the styles connate at the base, bifid, recurved. Capsule 1.5 mm. long and broad, green, shining. Seeds light-brown.

Along the Bopi River, 3,000 feet, *H. H. Rusby,* September 12, 1921 (*no. 662, type*). Also near Rurrenabaque, 1,000 feet, *M. Cardenas,* December 1, 1921 (*no. 1746;* this form about 3 dm. high).

Phyllanthus ichthyomethius

Subglabrous, the stems roughly nodose from the fallen branchlets, flexuous, densely branched, the branches slender, more or less angled or sulcate, densely leafy. Petioles 1 or 2 mm. long, very slender, minutely puberulent. Blade 1 to 3 cm. long, 5 to 15 mm. wide, ovate, often slightly inequilateral, with blunt base and mostly obtuse summit, entire, thin, bright-green, the venation sparse and very slender. Fascicles many-flowered, the filiform pedicels sometimes more than 1 cm. long. Only staminate flowers found, the perigone 6-parted nearly to the base, the segments nearly 2 mm. long, oblong, the outer three somewhat broader than the inner. Stamens 6, not quite half the length of the perigone, the filaments connate at the base, the anthers minute.

Near Rurrenabaque, 1,000 feet, *O. E. White,* October 8, 1921 (*no. 886*). "A shrub, to 10 feet high, with greenish-white flowers. Leaves used as a fish poison, and said to be the strongest of three varieties there used. Often planted in door-yards."

Phyllanthus prunifolius

(Fruiting specimens.) Glabrous. Branchlets elongate, slender. Petioles 2 mm. long. Blades to 8 cm. long by 3 cm. wide, lanceolate with rounded base and acuminate acute or acutish summit, entire, or obsoletely serrate-dentate, thick, the slender venation sharply prominent beneath, the secondaries 6 or 8 on each side, strongly ascending, crooked and irregular, connected by few crooked tertiaries, the finer venation coarsely and strongly anastomosing. Racemes sessile, mostly 2 or 3 together in the axils or along the nodes of naked branchlets, flexuous, several-flowered, bearing persistent small subulate bracts. Fruiting pedicels 2 or 3 mm. long, filiform, the persistent calyx spreading or reflexed, deeply 6-parted, 2.5 to 3 mm. broad, the divisions white, membranaceous, oblanceolate, obtuse. Berry red, 3 mm. long and nearly as broad, obovoid, triquetrous, the summit depressed in the center, the persistent styles 3, distinct, filiform, somewhat recurved, 1 mm. long.

On the River Ibon, 800 feet, *M. Cardenas,* February 15, 1922 (*no. 2085*). "A small shrub, with red berries."

Croton flavispicatus

(Section Decarinium.) More or less scabrous throughout, with very short stellate hairs. Stems rather stout, coarsely angled or sulcate, light-gray. Leaves alternate, both petioles and blades very unequal. Petioles to 3 cm. or more long, rather stout, channeled, the glands at the summit small, narrow, black. Blades to 1 dm. long and half or more as wide, ovate with rounded or slightly cordate, often inequilateral base, and acuminate and acute summit, entire, yellowish-green and scabrous above, whitish and slightly scabrous beneath, the principal veins lightly impressed above, strong and prominent beneath; obscurely 5-nerved, the secondaries 6 or 8 on each side, ascending at about 45°, connected by crooked tertiaries. Some spikes appearing axillary, but really terminating undeveloped branches.

Spikes 2 to 4 cm. long, often 1 cm. broad, conic, obtuse, yellowish, densely flowered. Bracts about 1 cm. long, narrowly subulate or nearly setaceous, thick, acute.

Male flowers: (Only buds seen.) Pedicels short, slender. One calyx-lobe wanting or minute, the fourth smaller than the other three, which are broadly ovate, thick. Open flowers not seen. Stamens 10, the filaments in the bud 1.5 to 2 mm. long, dark-brown, slender, pilose, a little longer than the anthers.

Female flowers: Several at the base of the spike, sessile. Calyx-lobes 3, sometimes with vestiges of the other two, about 4 mm. long and more than half as wide, green with a broad yellow middle portion, thick and rigid. Ovary broader than long, about 2 mm. broad, densely hairy. Styles densely hairy, nearly 4 mm. long, deeply bifid, the summit incurved. Capsule globose, about 4 mm. long.

Ixiamas, 800 feet, *M. Cardenas,* December 20, 1921 (*no. 2026*).

Croton Buchtienii

Rough grey-hairy throughout. Herbaceous, the stems stout, the branches slender, suberect, flexuous. Petioles 3 to 5 mm. long, thick. Blades 1.5 to 3 cm. long, 1 to 1.5 cm. broad, ovate with rounded base and acute or obtuse summit, coarsely serrate-dentate, deep-green above, gray beneath, subtrinerved, the venation very stout and prominent beneath. Inflorescence too young for description, but taken, as given below, from specimens collected by Buchtien.

Near Reyes, 1,000 feet, *H. H. Rusby,* October 26, 1921 (*no. 1332*).

Otto Buchtien's *no. 1362,* collected at San Gabriel, Mapiri, 750 meters, August, 1907, distributed as "*C. chamaedraefolium* Griseb.," is evidently the same and yields the following characters:

Flowers (unopened in my specimen) borne in a short, few-flowered flexuous raceme, partly concealed among the upper leaves, the pedicels short, subtended by subulate bracts about as long as themselves. Fruiting sepals linear, distinct, unequal, shorter than the capsule, which is about 3 mm. long and broad, light-brown, shortly stellate-hairy, lightly 3-lobed.

Acalypha Douilleana

Young portions, petioles, etc., minutely gray-puberulent. Branchlets slender, leafy. Stipules 5 to 7 mm. long, setaceous. Petioles 2 to 8 cm. long, very slender, narrowly grooved above. Blades 10 to 12 cm. long, 3 to 6 cm. broad, ovate, with rounded base and abruptly and acutely acuminate summit, lightly serrate-dentate, very thin, bright-green, the venation very slender, not prominent, the secondaries about 6 on each side, including the basal pair of nerves, strongly falcate-ascending, connected by numerous straightish tertiaries. Terminal spike pistillate, sessile but interrupted at the base, densely flowered elsewhere, about 7 or 8 mm. thick, purple with the numerous stigmas. Staminate spikes solitary in the axils, very small, with or without a basal pistillate flower. Bracts of the pistillate flower green, about 4 mm. long, divided nearly to the base into 7 to 9 narrowly linear pilose lobes, the outer of which are successively shorter. Ovary spheric, about 1 mm. in diameter, minutely muricate. Stigmas purple, distinct, 7 or 8 mm. long, bearing a few linear lobes. Staminate flowers undeveloped.

Canamina, 4,000 feet, *H. H. Rusby,* July 15, 1921 (*no. 74*). "A shrub, 4 feet high, in rich shaded soil in edge of forest." Species dedicated to Mr. A. Douille, the generous manager of the Canamina plantation, to whose kind assistance the party owes much of its success.

Acalypha variegata

Softly pubescent with gray hairs, those of the stem more or less retrorse or divaricate. Monœcious, the pistillate spike terminal, the staminate solitary in the axils. All parts of the plant extremely variable in size. Stems rather stout, lightly angled. Stipules 5 to 8 mm. long, subulate and attenuate. Petioles to 4 or 5 cm. long, stout, flattened or grooved on the upper surface. Blades to 1 dm. or more long, and 5 or 6 cm. wide, ovate with subrotund base and abruptly acuminate and acute summit, serrate, rather thin, purplish, especially when young, densely and softly gray-hairy beneath, rough-hairy on the principal veins above. Venation slender, but appearing stout beneath by their dense hairiness, the secondaries 8 or 9 on each side, strongly falcate, loosely connected by the tertiaries. Staminate spikes immature, 1 or 2 cm. long. Pistillate spike solitary, shortly and stoutly peduncled, 8 to 10 mm. wide, dense. Petioles of the bracts 1 to 1.5 mm. long, the bract concave, the inner side short and toothed, the outer side about 11-parted, the segments narrowly subulate, the terminal more than 2 mm. long, the lower successively shortened, all acuminate and acute, gray-hairy. Calyx white, densely pilose, broader than long. Stigmas exceeding the bracts, stout, recurved, pinnately many-parted, bright purple.

At Canamina, 4,000 feet, *O. E. White,* July 30, 1921, without number. "10 to 15 feet high, the juice milky." Species very near *A. Douilleana.* Named in allusion to the strong contrast, in the spike, between the purple stigmas and white calyx.

Acalypha vermifera

Young portions minutely downy. Stems much branched, the branchlets elongate, slender. Stipules 3 to 5 mm. long, subulate, consisting chiefly of a long awn-like attenuation. Petioles 2 to 5 mm. long, very slender. Blades 3 to 7 cm. long, 1 to 2 cm. broad, lanceolate, with rounded base and acuminate and acute summit, sharply short-serrate, thin, deep-green, the slender venation very prominent on the lower surface, the secondaries about 5 on each side, strongly ascending, the reticulation very loose. Spikes numerous, 1 to 2.5 cm. long, 1 mm. thick, subsessile, the pistillate flower solitary at the base, the stigmas plumose and about as long as the calyx.

Huachi, 1,800 feet, *O. E. White,* September 2, 1921 (*no. 944*). *No. 6688,* collected by the author at the same place, September 22, "a small tree in cultivated ground," appears to be the same, although the spikes are much smaller and closely sessile. Name in allusion to the caterpillar-like appearance of the inflorescence.

Acalypha heteromorpha

(Pistillate plant.) Petioles, etc., minutely papillose, the upper leaf-surfaces sparsely short-strigose, the lower sparsely puberulent. Stems stout, green, irregularly sulcate. Petioles 1.5 to 2 dm. long, strongly sulcate. Blades 12 to 18 cm. long, and nearly as broad, ovate with subtruncate or slightly cordate base and a short acutish terminal point, shortly serrate-dentate, with obtuse teeth, very thin, deep-green, all the venation slender, prominent on the lower surface, the secondaries about 12 on each side, including a nerve-like pair from the base, connected by few straightish tertiaries, all branches connecting to form a strong line close to the margin. Spikes slender, subsessile, solitary in the axils, much shorter than the petioles, the pistillate flowers all of one form or of two forms in the same spike, those with short stigmas at the base. Bracts of the flowers having long stigmas bright-green, thin, semicircular or reniform, 3 mm. broad, flabellately nerved, lacerate-dentate, the teeth ending in a long seta. Ovary small, subglobose, pilose, the stigmas red, more than 1 cm. long, much-divided and pilose. Bracts of the flowers with short stigmas similar but broader. Stigmas similar but small, shorter than the calyx. Staminate plant not seen.

Rurrenabaque, 1,000 feet, *Martin Cardenas,* October 7, 1921 (*no. 1554*). "A tall shrub." Also collected by the author at the same place, October 4, 1921 (*no. 782*). This specimen bears no flowers with long stigmas, as does *no. 1554,* but it has a single spike of staminate flowers, about 5 cm. long and 2 or 3 mm. wide, rather densely flowered.

Acalypha bopiana

Shortly and densely gray-tomentellate throughout. Stems much-branched, the branches short, rather stout, terete. Stipules 5 or 6 mm. long, subulate with attenuate summit, reddish, pilose. Petioles 2 to 6 cm. long, terete. Blades 1 to 2 dm. long, 4 to 8 cm. wide, lanceolate, with rotund or subcordate base and short-acuminate and acute summit, finely and very lightly crenate-dentate, thin, grayish-green, the slender venation prominent beneath, the secondaries 10 or 12 on a side, in addition to 2 pairs of short basal nerves, regularly falcate-ascending, not interconnecting at the margin, connected by numerous tertiaries. Staminate spikes axillary, shorter than their leaves, sessile, slender and curving, about 2 mm. thick, densely flowered. Pistillate spike terminal, sessile, densely flowered, about 1 cm. broad. Bracts of the pistillate flowers about 6 mm. long and somewhat wider, the summit incisely dentate, the teeth attenuate, the middle one longer than the other, the edges connate at the base around the flower. Sepals 5, hyaline, pubescent, ovate, long-acuminate, about as long as the ovary, which is pubescent, broader than long, strongly lobed, the styles many times longer than the ovary, distinct almost to the base, sparingly plumose.

Cataracts of the Bopi River, 3,000 feet, *H. H. Rusby,* September 3, 1921 (*no. 478*). "A large shrub on the river-bank."

Dalechampia albibracteosa

Softly short-puberulent. Stems slender, elongate, finely striate. Stipules about 5 mm. long, lanceolate, acuminate, inequilateral. Petioles 2 to 6 cm. long, slender, terete, 2-ligulate at the summit on the upper side, the ligules linear, thickish, red. Leaves 5 to 10 cm. long and broad, cordate with broad rounded sinus, deeply 3- to 5-lobed, the sinuses acutish, the segments lance-ovate, acute, obscurely serrate-dentate, thin, puberulent beneath, sparsely so above, the venation slender, crooked, loosely reticulate. Racemes few-flowered, short-peduncled. Pistillate flowers usually 2 or 3, subtended by four bracts, which are about 1 cm. long and nearly as wide, ovate, acutish, strongly 3- to 5-nerved, thickish. Sepals 12, pinnatifid, the linear segments lacerate, greatly enlaring in fruit. Style very stout, sigmoid-curved, the stigma discoid, strongly oblique, nearly circular, coriaceous, the margin recurved, nearly 2 mm. broad. Staminate flower consisting of about 20 stamens which are nearly distinct. Capsule 1.5 cm. broad, nearly 1 cm. high, deeply 3-lobed, black and shining, partly concealed by the pinnate sepals.

Rurrenabaque, *Martin Cardenas,* November 24, 1921 (*no. 1793*). "A vine, growing in forest shade, the bracts white, the stigmas red."

Pera elliptica

Glabrous. Branchlets stout, leafy, roughened with the scars of the fallen leaves. Stipules about 5 mm. long, broadly ovate, obtuse or obtusish. Petioles 3 to 5 cm. long, slender. Blades 7 to 15 cm. long, 3 to 9 cm. wide, elliptic, the base slightly cordate and sometimes a little oblique; entire, coriaceous, the midrib stout, prominent beneath, the rest of the venation slender, lightly prominent on both surfaces, the secondaries 20 to 25 on each side, with some intermediate minor ones, somewhat decurrent on the midrib, widely spreading, the outer portions ascending, connected by crooked tertiaries, the venation strongly and rather loosely anastomosing. Flowers not seen. Fruits sessile, 1 cm. to 1.5 cm. broad, and not quite so long, lightly 3-lobed, the lobes lightly grooved, tipped by the subsessile discoid stigma, the surface dark-brown, more or less papillose.

San Buena Ventura, 1,000 feet, *M. Cardenas* (*no. 1781*). Local name "Caout-chouc."

Mabea elegans

Ferruginous-tomentellate. Branchlets slender, terete. Stipules 5 to 8 mm. long, linear, mostly obtuse. Petioles 5 mm. long, stout. Blades 5 to 8 cm. long, 2 to 3 cm. wide, lance-oblong, with rounded base and acutely mucronate summit, thickish, the upper surface nearly glabrous, with the midrib and secondaries often slightly impressed, prominent beneath, the secondaries about 12 on each side, connecting at some distance from the margin, their branches loosely reticulate along the margin. Racemes peduncled in the upper axils, sometimes branched. Bracts of the staminate flowers half as long as the pedicels, ovate, obtuse, thick, bearing two large oblong glands on the margin, about the middle. Pedicel stout, nearly 5 mm. long. Unexpanded flower depressed globose, nearly 2 mm. broad. Stamens numerous, small, connate for about half their length. Bracts of the pistillate flowers lance-linear, acuminate. Fruiting pedicel enlarged upward, recurved, the persistent sepals ovate, obtuse, 2-glandular like the bracts of the staminate flowers. Capsule subglobose.

On the Rio Ibon, 500 feet, February 18, 1922 (*no. 2379*). "Flowers greenish-yellow, a single pistillate flower at the base of each raceme."

CELASTRACEAE

Maytenus meguillensis

Glabrous, the branchlets short and rather stout, terete, the leaves alternate. Petioles 5 to 10 mm. long, broad, cartilaginous, mostly twisted in drying, the margins strongly up-curved. Blades 6 to 10 cm. long, 3 to 6 cm. broad, oval, with subrotund base and obtuse summit, entire or very obscurely sinuate-dentate, the slender venation slightly prominent above, strongly so beneath, the secondaries 10 to 15 on a side, with intermediate smaller ones, abruptly ascending at the base, then spreading widely, and again strongly ascending to connect at some distance from the margin, the intervening venation loosely anastomosing. Cymes compound, peduncled, short and broad, little exceeding the petioles, densely flowered, the bracts very short and broad, the flowers on extremely short, stout, angled pedicels, the flowers 6 to 7 mm. broad when fully expanded. Calyx-lobes very thick, broader than long, with broadly rounded summit, less than half the length of the petals, which are 2.5 mm. long and nearly as broad, the base truncate, the summit rounded, the margin faintly denticulate. Stamens about half as long as the petals, recurved, the anthers short and broad. Disk plane, 3 mm. broad, thick and fleshy, 5-grooved and lightly lobed. Stigma sessile, capitate, depressed.

On the Meguilla River, 3,500 feet, *H. H. Rusby,* August 14, 1921 (*no. 307*). The same collected in the same locality, *O. E.*

White, July 29, 1921 (*no. 434*). A large tree with yellowish-green flowers.

Maytenus Cardenasii

(Mature fruiting specimens.) Glabrous, the branchlets slender, gray or purplish-gray. Leaves 4 to 9 cm. long, 1 to 2.5 cm. wide, lance-oblong, abruptly contracted into a short, obtuse acumination at the summit, very abruptly contracted into a petiole-like base 2 or 3 mm. long, with incurved or involute margins; upper portion of the margin obsoletely serrate; coriaceous, deep-green, slightly shining above, the venation scarcely prominent on either side, the strongly ascending secondaries 12 to 15 pairs, often with a few smaller ones alternating at the basal portion. Fruits solitary or 2 or 3 together in the axils, the pedicels 2 or 3 mm. long, stout, purplish, the persistent thickish calyx 2 mm. broad, shallowly lobed, the fruit 8 to 10 mm. long, and more than half as broad, ellipsoid, deep-purple, the aril light-reddish.

San Rafael, near Reyes, 1,000 feet, *M. Cardenas,* October 29, 1921 (*no. 1379*). Species near *M. erythrocarpa.*

Maytenus erythrocarpa

(Fruiting specimen.) Glabrous, the branchlets gray, slender, somewhat flexuous, subterete. Leaves alternate, the reddish petioles about 6 mm. long, broad. Blades 6 to 10 cm. long, 3 to 5 cm. wide, oblong or oval, with obtuse base and abruptly short-pointed obtuse summit, shallowly serrate-dentate, gradually becoming entire toward the base, thick and coriaceous, very pale-green, the venation very slightly prominent beneath, the very slender, crooked secondaries about 15 to 20 pairs. Cymes terminal, shortly peduncled, bearing 4 to 8 mature fruits. Pedicels about 5 mm. long, stout, somewhat scurfy, dark-brown. Unopened fruit broadly oval or subglobose, about 1 cm. long, brownish-red, dehiscing nearly to the base, the thick valves spreading widely and displaying a two-lobed aril of the same color that completely conceals the blackish, compressed seed. The fruit is yellow before being dried.

Near Rurrenabaque, 1,000 feet, *Martin Cardenas,* December 1, 1921 (*no. 1737*). A small tree of the forest.

HIPPOCRATEACEAE

Salacia arborescens

(ANTHODON.) Glabrous, the branchlets slender, terete, or the upper portions of the internode lightly ribbed, the leaves opposite. Petioles 1 to 1.5 cm. long, stout, margined, the margins upcurved. Blades 1 to 1.5 dm. long, 4 to 8 cm. broad, ovate with rounded or obtuse base and obtuse or obtusish summit, shallowly and obtusely sinuate-dentate, thickish, the slender venation very lightly prominent on both sides, the secondaries about 8 on a side, strongly ascending, connected by straightish veins. Cymes compound, at length recurved, little longer than the petioles, peduncled, densely flowered, the bracts and bractlets broader than long, mostly obtuse, the flowers sessile or subsessile, 2 or 3 mm. broad. Sepals about half the length of the petals, broader than long, the summit rounded. Petals oval or subrotund, with rounded summit. Disk crateriform, lightly sinuate. Stamens 3, about twice the length of the disk, or more, erect, extrorsely dehiscent. Stigma sessile, three-parted.

Bopi River Valley, 3,000 feet, *H. H. Rusby,* September 2, 1921 (*no. 562*). A large tree on the river-bank.

SAPINDACEAE

Paullinia ingaefolia

Inflorescence and flowers ferruginous or gray-tomentellate, the branches stout, irregularly and heavily angled and sulcate. Leaves extremely variable in size, the longest more than 3 or 4 dm. long, sessile or with a long, winged petiole, the leaflets 5, the joints of the rachis broadly winged, the wings herbaceous, successively wider upward and wider toward their upper part, the widest as much as 1.5 cm. on each side. Leaflets sessile, blackish glandular at the base, the largest 1.5 dm. long, and 8 cm. wide, oblong or oval, rounded or obtuse at both ends, entire or with one or two obscure teeth toward the summit, thickish, the midrib and 8 to 10 secondaries on each side mostly depressed above and strongly prominent beneath, glabrous above, sparsely and coarsely pilose on the veins beneath, finely and strongly reticulate-veined. Panicles spiciform, cylindric, densely flowered, sessile, 5 to 8 cm. long in my specimens, 1 to 1.5 cm. thick, subtended by a pair of coriaceous, ciliate, brown, many-ribbed oblanceolate obtuse bracts about 2 cm. long, these apparently substituting the tendrils, which are not present.

Rurrenabaque, 1,000 feet, *O. E. White,* October 15, 1921 (*no. 1275*).

Paullinia pendulifolia

Younger portions and inflorescence finely or sparsely puberulent, the branchlets and branches of the inflorescence strongly ascending, often recurved toward the summit, strongly sulcate, deep-purple. Petioles 1 to 2 cm. long, 2 or 3 times as long as the rachis and, like it, narrowly winged, with the wing puberulent and involute on drying, the leaflets 5, sessile, more or less pendulous, the four lateral subequal, the terminal a little larger, from 2.5 to 5 cm. long, 1.5 to 3 cm. wide, oval with rounded base (the terminal acutish), and obtusish summit, all nearly equilateral, with 3 strong obtuse teeth above the middle, thick, glabrous and sublucid, the midrib and secondaries impressed above, strongly prominent beneath, the latter about 8 on a side, stout, ascending, rather crooked, the intervening venation densely and strongly anastomosing. Panicles racemiform, 1 to 1.5 dm. long, including the peduncle, not more than 1 cm. broad, densely flowered, the branchlets mostly 2- to 4-flowered, the pedicels very short, slender, the bracts setaceous, much longer than the pedicels, the flowers, as pressed, 5 to 7 mm. broad. Fruit about 18 mm. long, including the stipe, which is nearly a third of the length, 1 cm. broad, pyriform, very shortly and stoutly mucronate, and bearing a short connate style-base, the cells empty in all my specimens.

On the pampas near Lake Rogagua, 1,000 feet, *H. H. Rusby*, November 4. 1921 (*no. 1622*).

Paullinia quercifolia

Glabrous, the branchlets elongate, slender, heavily sulcate. Leaves normally 5-foliolate, but the lowest pair of leaflets frequently wanting and represented by a pair of blackish glandular depressions. Petioles below these glands or leaflets 8 to 12 cm. long, not margined, 5- to 7-costate. Rachis 5 to 7 cm. long, similar to the petiole. Leaflets short-petioled, the lateral all subequal, 12 to 20 cm. long, 6 to 8 cm. broad, oblanceolate, with short-acuminate base and very short obtuse terminal point, shallowly and irregularly sinuate above the middle, thickish, lucid, the midrib and secondaries lightly prominent above, sharply so beneath, the latter about 12 on a side, slender, ascending at about 45 degrees, straightish, abruptly upcurved at the end, to connect 3 or 4 mm. from the margin, the finer venation loosely reticulate. Tendrils wanting. Panicles racemiform, sessile or subsessile, about 1 dm. long, 1.5 cm. broad, the subtending bracts mostly linear, ribbed, densely flowered, the branches mostly 5- to 7-flowered, the bractlets minute, subulate, the flowers slenderly pedicelled, the pedicels about as long as the flowers, recurved, the flowers 2 mm. wide.

On the Rio Ibon, 800 feet, *Martin Cardenas,* February 15, 1922 (*no. 2080*). "An erect shrub, about a meter high, in forest shade, the flowers white." The species is peculiar in its erect habit and its tendency to trifoliolate leaves.

Paullinia ribesiaecarpa

Branchlets and inflorescence sparsely and very minutely gray-puberulent, the branchlets slender, irregularly sulcate. Petioles about 5 cm. long, more than twice the length of the rachis, slender, lightly sulcate and angled. Leaflets 5, the petiolules 3 to 5 mm. long, the blades 4 to 8 cm. long, 1.5 to 3 cm. broad, slightly inequilateral, lance-oblong, with acute base, acutish, or usually with a very abrupt, short obtuse point; some entire, but mostly with several unequal obtuse teeth, with acute sinuses, toward the summit, bright-green, thickish, the venation stout; 5 or 6 ascending secondaries on each side, falcate, with a fine and strong intervening reticulation. Flowers not seen. Nearly mature buds 1 mm. broad, subglobose, on short pedicels, the panicles narrow and racemiform. Fruiting peduncles about 5 cm. long, slender, more than double the length of the fruiting portion, the simple tendrils at its base, strongly flattened, circinate. Fruits with abruptly contracted pedicel-like base, crimson, mostly inequilateral, 8 mm. long and about as broad, finely many-wrinkled, the summit mostly slightly depressed and bearing 3 small styles. Seed solitary, brown, wrinkled, shining, 5 mm. broad, the basal half enclosed in a gray 2- to 3-lobed aril.

Reyes, 1,000 feet, *H. H. Rusby,* November 12, 1921 (*no. 1730*).

RHAMNACEAE

Karwinskia oblongifolia

(Fruiting specimen.) Very finely and softly gray-tomentellate, the upper leaf-surfaces bright-green and subglabrous. Branchlets slender, terete, ascending, leafy. Leaves opposite, the stipules 1 or 2 mm. long, broadly ovate. Petioles mostly 6 to 9 mm. long, slender, the margins strongly involute. Blades 5 to 10 cm. long, 2 to 3.5 cm. wide, narrowly or broadly oblong, with acute base and acute mucronate summit, entire, the slender midrib and 10 or 12 pairs of secondaries mostly narrowly channeled above, sharply prominent beneath, the straightish secondaries ascending at an angle of about 45 degrees and connected by innumerable straightish tertiaries. Cymes short-peduncled, 2- to 4-fruited, the pedicels slender, about half as long as the fruits, which are 8 to 10 mm. long and two thirds as broad, ellipsoid or slightly narrower at the base, sometimes tipped with a short style-base. Fruiting calyx 2 to 3 mm. broad, shallowly crateriform, bearing 5 very short setaceous teeth.

On the pampas about Lake Rogagua, at about 1,000 feet, *Martin Cardenas,* November 1, 1921 (*no. 1394*).

This was a shrub, about a meter high, on the lake margin. Mr. Cardenas collected it as a good-sized tree a few days later, in the same locality (*no. 1632*). This specimen has leaves a half larger, and of narrower form. The writer collected it as a small tree, about fifty miles nearer the Beni River, November 12 (*no. 1724*), the fruit reported as being edible. The species is near *K. Humboldtiana* of Mexico.

Elaeocarpaceae

Sloanea xylocarpa

(Fruiting specimens.) Petioles, principal veins of the lower surface, etc., tomentellate. Branchlets stout, leafy. Petioles 2 to 3 cm. long, the blades 10 to 15 cm. long, 6 to 10 cm. wide, ovate, with broad or subtruncate base and blunt summit, obscurely sinuate, thick, dark-green, the midrib and some of the secondaries lightly grooved above, very stout and prominent beneath, the secondaries about 12 on a side, ascending at about 45°, lightly falcate, connected by straightish tertiaries, the venation very finely and strongly reticulate. Panicles lax, long-peduncled, the peduncles very stout. Capsules brown, shortly and stoutly pedicelled, 2 to 2.5 cm. long, densely and unequally tuberculate, the tubercles aristate, the aristae terete, weak and irregularly curved. Valves 4, thick and woody. Seed about 1 cm. long, obovoid, with a broad, light-colored highly convex cap at the larger end, apparently a strophiole.

Tumapasa, 1,500 feet, *M. Cardenas,* December 9, 1921 (*no. 1979*).

Sloanea fragrans

Inflorescence gray-tomentellate. Branchlets very stout. Petioles of the larger leaves 2 dm. long, 7 mm. thick, terete, hollow, strongly nerved. Blades to 7 dm. long and 3 dm. broad, obovate, obtuse, with rounded base, the margin obscurely sinuate, obsoletely dentate, coriaceous, drying brownish, the midrib very stout, the secondaries 15 to 20 on each side, spreading widely, the outer portions strongly falcate, connected by a number of crooked, slender tertiaries, the venation strongly and finely anastomosing, lightly prominent on both surfaces. Flowers racemose, the racemes solitary or variously clustered, mostly longer than the petioles, only the terminal portion usually floriferous, the peduncle and rachis stout, coarsely angled or sulcate. Bracts 5 to 7 mm. long, boat-shaped, keeled, acute, coriaceous. Pedicels mostly about twice the length of the bracts, stout, many-costate. Sepals about 8 mm. long and half as broad, very thick, especially at the base, tomentose on both surfaces, lanceolate, obtusish, the petals similar. Stamens very numerous, densely massed, the thick fleshy filament about as long as the thecae, the anther narrowed toward the base, about 7 mm. long, the acuminate, acute, rigid appendage about a third of its length, the anther about 1 mm. wide, or less, gray-puberulent, the appendage yellow, subglabrous. Ovary short-ovoid, 4 or 5 mm. wide, densely short-scaly, the style tomentose, stout, tapering, a little longer than the stamens. Fruit depressed-globose, reaching to 2 dm. in breadth, densely long-spinose. Seeds 2 or 3 cm. in width, irregularly ovoid, light-scarlet.

On the shore of the Bopi River, 3,000 feet, *H. H. Rusby,* September 8, 1921 (*no. 742*). Local name ''Cabeza del Negro'' (Negro-head). A large forest tree, flowering while still bearing some fruits of the preceding crop. Its flowers are abundant, and a beautiful combination of pink and yellow, and very fragrant. In many places, the forest floor is covered with the chestnut-like seeds, or with their remains, dropped by parrots and other birds which feed eagerly upon them. There were indications that terrestrial animals devour those which fall.

Tiliaceae

Corchorus aquaticus

Gray-puberulent, especially above, the hairs of the stem very short, many of them retrorse. Stems to 4 dm. high, mostly simple, slender, mostly angled or sulcate, herbaceous. Stipules setaceous, 2 or 3 mm. long. Leaves very heteromorphous, very small or rudimentary at the base, where they are ovate or oval, becoming longer and narrower upward, the uppermost often 5 cm. long and only 3 to 5 mm. wide, all except the lower inclined to be erect or ascending. Blades thin, pale-green, the slender petioles about a sixth of the length; acuminate at both ends, acutish at the summit, finely and sharply serrate, subtrinerved, the secondaries numerous, erect or suberect. Flowers axillary and in a short few-flowered raceme at the summit, the pedicels filiform, about 8 mm. long. Sepals 5, 1 cm. long, 3 mm. wide, lanceolate or oblanceolate, acuminate, acutish, pilose. Petals about half as long as the sepals. Stamens numerous, two thirds the length of the sepals, exceeding the style. Ovary oblong, about as long as the stout style, obtusely angled. Capsule 4 cm. long, 3 or 4 mm. broad, linear, lightly curved, abruptly short-mucronate, the spreading pedicel one fourth the length of the capsule.

Near Reyes, 1,000 feet, *O. E. White*, October 28, 1921 (*no. 1517*). "An herb, 5 to 10 inches high, in damp bog, in big swamp." Also collected by the author, in the same locality, growing in shallow water, in sunshine (*no. 1445*).

MALVACEAE

Abutilon laxum

More or less hairy throughout, in varying form. Branchlets elongate, slender, ascending. Petioles to 5 cm. long, slender, short pilose. Blades 5 to 15 cm. long, 4 to 10 cm. wide, ovate, cordate, acuminate and acute, dentate with short or nearly obsolete broad teeth, thin, rather harsh to the touch, deep-green and scabrellate above, pale-green and stellate-scurfy beneath, mostly 7-nerved, the nerves slender, sharply prominent beneath, connected by a loose reticulation. Flowers crowded at the ends of the branchlets, the pedicels slender, about 3 cm. long in flower, 5 or 6 cm. in fruit. Calyx ferruginous, 1 cm. or more in length, divided about two thirds of the length, thick, the lobes ovate, mucronate. Corolla about twice the length of the calyx, rose-colored. Carpels 10, nearly 1.5 cm. long, truncate, obtuse, tomentellate.

Along the Bopi River, 3,000 feet, *H. H. Rusby,* September 11, 1921 (*no. 658*). The same collected in Bolivia by M. Bang, without number or date. Of this Mr. E. G. Baker says that it is nearly allied to "*Sida globifera* Hooker," which is *Abutilon.*

Wissadula filipes

Densely and closely stellate-tomentellate, the lower leaf-surfaces white, or the younger ones yellowish. Branches slender and lax. Stipules small, subulate with setaceous summit. Petioles to 1.5 cm. long, slender. Blades to 5 cm. long, 4 cm. wide, deltoid-ovate, with truncate or subcordate base, obtuse or acutish, entire or obscurely crenate-dentate, the 5 nerves strong and prominent beneath, lightly impressed on the green upper surface. Panicle large, very lax and open, the branches almost filiform, subtended by minute leaves. Flowers solitary on long filiform pedicels. Calyx 4 mm. broad, divided more than half way, the lobes ovate, acutish. Fruit 7 mm. broad, the carpels rostrate, the beak short, stoutly conic, acute, spreading.

On the pampas near Lake Rogagua, 1,000 feet, *M. Cardenas,* November 4, 1921 (*no. 1623*). Species closely resembling *W. Fadyenii.* It is also near *W. periplocifolia,* but the form of its very small carpels is quite different.

Pavonia ageratoides

Finely puberulent, and pilose with longer divergent rigid white hairs. Stems stout, the branchlets short and leafy. Stipules mostly reflexed, about 4 mm. long, subulate, acuminate and acute, green. Petioles 1 to 3 cm. long, slender, divergent or somewhat reflexed. Blades 2 to 4 cm. long and about equally broad, ovate, cordate, acute or very shortly acuminate, finely and regularly crenate-serrate, thin, deep-green above, gray-green beneath, slenderly 5- to 7-nerved. Pedicels axillary, solitary, very slender, twice as long as the petioles. Bracts mostly 7, about 8 mm. long, 0.5 mm. wide, linear, acute, herbaceous, pilose. Calyx about two thirds the length of the involucre, lobed about half way, herbaceous, pilose, the lobes ovate, obtusish. Corolla 2 or 3 times as long as the calyx, yellow but drying to pink, finely veined. Stamens about two thirds the length of the petals.

Canamina, 4,000 feet, *O. E. White,* July 21, 1921 (*no. 276*). "A herb, 6 to 15 inches high, in sunny places along irrigating ditches, the flowers yellow."

Pavonia canaminensis

Softly tomentellate with stellate hairs. Stems stout, the branchlets short. Stipules 1 cm. or more long, subulate with elongate linear summit. Petioles about 5 mm. long, stout. Blades 3 to 10 cm. long, 2 to 5 cm. wide, ovate with rounded base and acute summit, irregularly serrate-dentate, thickish, deep-green, flabellately 4- or 5-ribbed, the ribs strong on the lower side. Pedicels slender. Bracts 7, about 1 cm. long, 2 to 2.5 mm. wide, oblanceolate, obtusish, green. Calyx two thirds the length of the bracts, divided about half-way, the lobes ovate, acute, ciliate, green, with a strong midrib. Petals about twice as long as the bracts, exceeding the stamen-column.

Canamina, 4,000 feet, in cultivated ground, along ditches, *H. H. Rusby,* July 15, 1921 (*no. 85*).

Pavonia subtriloba

Subsetose with rigid, white, divergent hairs. Stipules 4 or 5 mm. long, lanceolate, acuminate and acute, green. Petioles about a fourth the length of the blades, terete. Blades 3 to 5 cm. long, 1.5 to 4 cm. broad, triangular-ovate, with (or the upper without) a pair of short basal lobes, with shallowly cordate base and obtuse summit, lightly and irregularly crenate-dentate, thickish, pale beneath, 3- to 5- or 7-nerved with connecting secondaries, the loose reticulation lightly prominent beneath. Flowers axillary, mostly solitary, the peduncles nearly equaling the leaves. Bracts 7 to 10, nearly twice the length of the calyx, narrowly linear, green, pilose. Calyx herbaceous, divided more than half way, the lobes triangular-ovate, acute. Petals about twice the length of the calyx and about 1 cm. long, yellow, but drying to a rose-color. Fruit not mature.

Canamina, 4,000 feet, *O. E. White,* July 19, 1921 (*no. 512*). "A herb 4 or 5 feet high, in cultivated ground, the flowers yellow."

PELTOBRACTEA gen. nov.

Involucral scales stipitate and peltate. Calyx 5-lobed, costate, rigid, the lobes broad, acute. Petals 5, obovate, venose. Stamen-tube very shortly 5-toothed at the summit, the anther-clusters tending to a zonal arrangement, one circle near the summit, the other below the middle, with additional scattered clusters, the free portions of the filaments very slender, the anthers short and broad, obcordate, the thecae diverging upward and separated by a broad connective. Ovary 5-celled, the cells 1-ovuled. Style 10-lobed, the lobes short, the stigmas discoid. Capsule not appendaged, 5-lobed, 5-celled, 5-seeded, the cells loculicidally dehiscent. Seeds incurved, margined, the margins thickened.

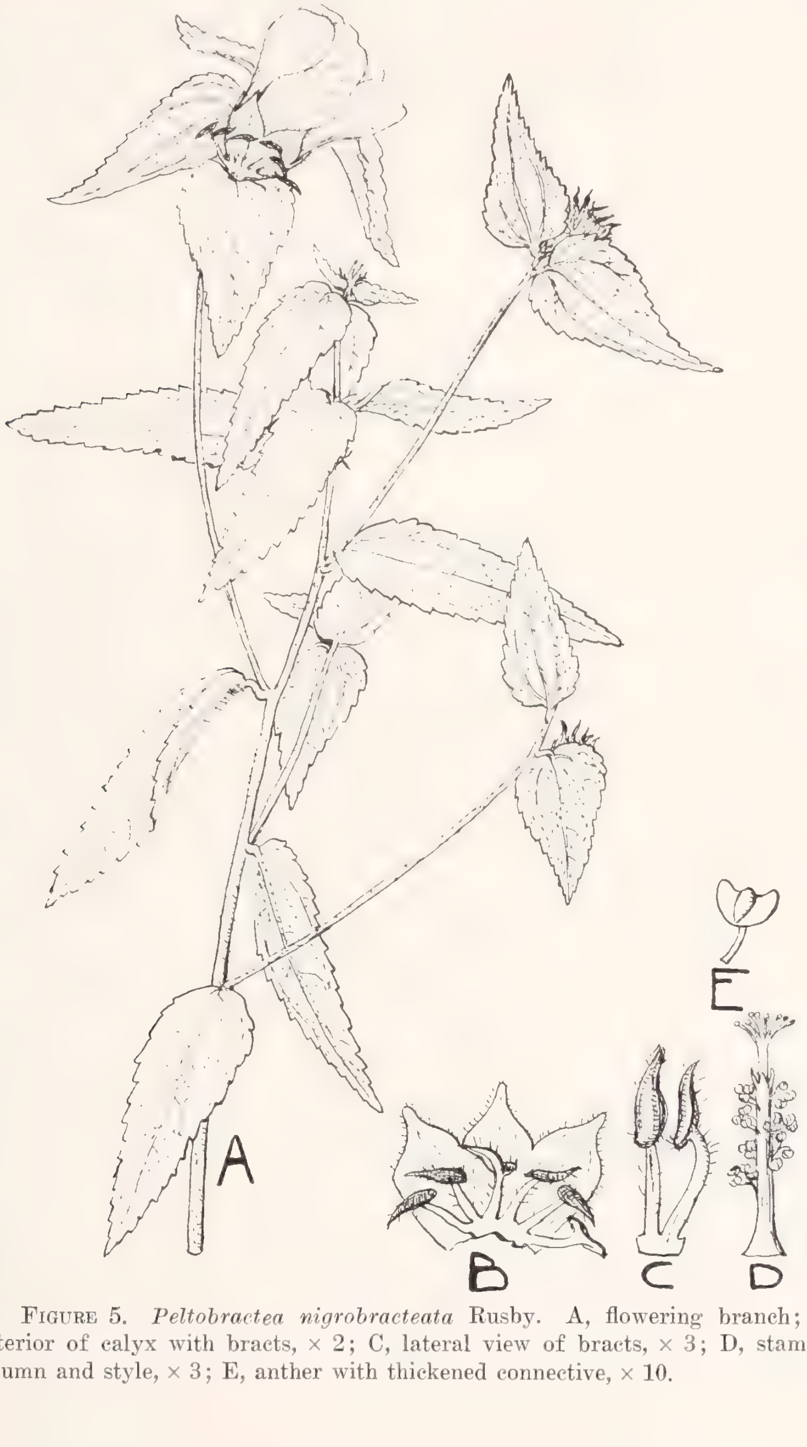


FIGURE 5. *Peltobractea nigrobracteata* Rusby. A, flowering branch; B, exterior of calyx with bracts, × 2; C, lateral view of bracts, × 3; D, stamen-column and style, × 3; E, anther with thickened connective, × 10.

The affinity of the genus is obviously with *Pavonia,* but its peltate bracts, peculiarly separated thecae, and unappendaged carpels effectually exclude it from that genus.

Peltobractea nigrobracteata

Lightly scabrous, the inflorescence pilose. Stems slender, terete. Stipules 5 or 6 mm. long, subulate, attenuate. Leaves subsessile, 2.5 to 5 cm. long, 7 to 15 mm. wide, lanceolate, with rounded, sometimes subcordate base and acuminate acute summit, serrate-dentate, pale-green, thick and rigid, 3-nerved, the nerves impressed above, very strong and prominent beneath, like the loosely reticulate venation. Flowers solitary or few, in the upper axils, very shortly pedicelled. Bracts of the involucre 10, stipitate, peltately attached to the stipe at about a third of their length. Stipes lightly connate at the base, half the length of the calyx, terete, whitish, pilose. Limb more than half the length of the stipe, lanceolate, with rounded base and acute summit, thick and rigid, concave beneath, pilose, purple-black in the dried state (in the fresh state?). Sepals about 1 cm. long, 7 mm. broad, ovate, acuminate and acute, whitish, with 5 strong green ribs, connate for nearly half their length. Petals 1.5 cm. long, 1 cm. broad, obovate with rounded summit, pink. Styles shorter than the petals, the branches 2 mm. long, the stigmas discoid. Stamens not numerous. Capsules about 8 mm. broad, 4 mm. high, lightly 5-lobed, depressed in the center, light-brown, sparsely rough-hairy.

On the pampas at Rosaria, near Lake Rogagua, 1,000 feet, *M. Cardenas,* November 4, 1921 (*no. 1654*). Also at Ixiamas, 1,000 to 1,500 feet, *O. E. White,* December 15, 1921 (*no. 1123*). Dr. White says "An herb, 2 to 3 feet high, with salmon-pink flowers, growing in sunshine, in damp clay-loam."

Hibiscus rectiflorus

Gray-tomentellate throughout. Stems tall, stout, little branched or simple, more or less sulcate or angular, the flowers solitary in the axil. Stipules 5 or 6 mm. long, lance-linear, attenuate and acute. Petioles 1 to 2 cm. long, stout, shallowly grooved above. Blades 6 to 10 cm. long, 2 to 3 cm. broad, oval or oblong, with rounded base and acute summit, entire, thick and rigid, light-green above, gray beneath, where the venation is strongly prominent and closely and strongly anastomosing, the secondaries about 8 or 10 on each side, strongly ascending.

Flowering peduncles to 5 cm. long, erect, terete, dilated at the summit. Bracts 10, distinct, unequal, shorter or longer than the calyx, linear or slightly broader above, obtuse, thick, with very strong midrib. Calyx 15 to 18 mm. long, the sepals nearly distinct, lanceolate, acutish, very thick, 3-nerved, the midrib very stout. Corolla about 5 cm. long, papillose or scurfy externally, light-yellow with reddish center.

Near Reyes, 1,000 feet, *O. E. White,* October, 1921 (*no. 1538*). "A foot or two high, in pampas, in sunshine."

Hibiscus rhomboideus

Densely gray-tomentose throughout. Stem stout, terete, branched above. Stipules very small, linear or setaceous. Petioles 3 to 5 mm. long, very thick. Blades 3 to 4 cm. long and nearly as wide, ovate with truncate subcordate base and blunt summit, very finely crenate-dentate, thick, gray-green on both sides, 5-ribbed, the ribs thick, prominent beneath, the secondaries only one or two on a side. Flowers several, crowded at the ends of the branches, the pedicels very short. Bracts linear or stoutly setaceous, mostly a little shorter than the calyx, 1.5 cm. long, divided half way, the lobes ovate, acute, thick, with strong midrib. Corolla (imperfect) apparently about 5 cm. long. Style-branches 10, about 2.5 mm. long, the stigma capitate.

On the pampas, near Lake Rogagua, 1,000 feet, *H. H. Rusby,* October 28, 1921 (*no. 1383*). "Scarce, in muddy places, the flowers rose-colored."

BOMBACACEAE

Bombax rurrenabaqueana

Glabrous. Petioles 3 to 8 cm. long, slender, grooved on the upper surface, the stipules subulate, acute, thick, rigid, 2 mm. long. Leaflets 5, occasionally 7 in my specimen, subsessile, 7 to 15 cm. long, 2 to 5 cm. wide, oblanceolate, the summit rounded, often slightly retuse and with a minute apiculation, the base sharply acuminate, entire, thin, pale beneath, the venation slender, prominent on both sides, strongly and rather coarsely reticulate, the secondaries about 10 on each side, crooked, widely spreading, then falcate and interarching a short distance from the margin. Flowers (always?) two together, the peduncles about 1.5 cm. long, very thick, ferruginous like the calyx, which is 2 cm. long, 1 cm. wide, cupulate, ferruginous-tomentose, truncate, with 2 or 3 irregular short teeth. Corolla about 1.5 dm. long, the segments greenish-dull-brown, linear-oblanceolate, ferruginous-tomentellate on both surface. Stamens very numerous, apparently in 10 phalanges, brown, nearly as long as the corolla. Style filiform, the stigma truncate or minutely 2-lobed.

Rurrenabaque, 1,000 feet, *H. H. Rusby,* October 7, 1921 (*no. 1571*). A small tree in the forest.

Sterculiaceae

Guazuma coriacea Rusby, Bull. N. Y. Bot. Gard. **4**: 332. 1907.

This species, well distinguished by its globose fruits, with the tubercles obtuse or unappendaged, has been known only in the fruiting state. *No. 1401* is in flower and appears identical with the species named, although this cannot be positively asserted without directly connecting collections of flowers and fruit. The following is a complete description of these flowering specimens:

Finely and closely grayish stellate-tomentellate. Branchlets elongate, straight, slender, terete or obscurely angled near the nodes. Stipules not seen. Petioles to 2 cm. long, rather stout, somewhat enlarged upward, terete, tomentose. Blades to 15 cm. long and half as wide, ovate, with rounded, truncate or subcordate base and acuminate and acute summit, finely and unequally crenate-dentate, rather thin, drying yellowish-green, the venation prominent beneath, the midrib strong, the secondaries slender, 6 to 8 on each side, with some small intermediate ones, ascending at about 45 degrees and lightly curved, connected by a coarse anastomosis. Cymes solitary in the axils, the peduncles mostly shorter than their petioles, the flowering portion usually a little longer than the peduncle. Bracts small, narrowly subulate. Pedicels shorter than the flowers. Calyx 2-parted, the segments 3 or 4 mm. long, strongly concave. Petals 5, yellow, the body 4 mm. long, narrowed at the base, strongly concave, the summit involute, bearing 2 linear ligules, 5 or 6 mm. long, united at the base. Stamen-tube campanulate, 2 mm. long and broad, the sterile lobes nearly as long as the anthers, acuminate but obtusish. Stamens apparently 5 in a cluster, the filaments united two thirds of their length. Style slightly longer than the stamen-tube, slightly 5-cleft. Fruit not seen.

In copses about Lake Rogagua, 1,000 feet, *M. Cardenas,* November 1, 1921 (*no. 1401*). "A large tree, with yellow flowers."

OCHNACEAE

Ouratea flexuosa

Glabrous, the branches recurved or flexuous, mostly stout, gray, more or less annulate. Leaves 6 cm. to 18 cm. long, and 2.5 to 5 cm. wide, mostly narrowly oblanceolate, with acuminate and acute summit, and long-acuminate base tapering into a short dark-brown margined petiole about 5 mm. long; thickish and rigid, slightly lustrous on both sides, finely and very sharply serrate, the venation slightly prominent on both sides, the midrib strongly so, the principal secondaries abruptly upcurved and then erect, connected with the midrib by numerous finer ones. Racemes terminal, short, densely flowered, the rachis thick, stout and nodose from the fallen flowers. Pedicel thick, nearly as long as the sepals, which are 6 to 7 mm. long, 2 mm. wide, lanceolate, thick, dark-colored. Petals about equaling the sepals, ovate, dark-yellow. Anthers subsessile, as long as the petals, narrowly lanceolate, the white pores very small. Ovary 1 mm. wide and about half as long, blackish, the stout stipe about 1.5 mm. long, the stout style equaling the stamens.

In the Bopi River valley, 3,000 feet, *Rusby & White,* August, 1921 (*no. 667*).

Ouratea macrobotrys

Glabrous, the branchlets elongate, slender, terete, densely leafy. Leaves 8 to 16 cm. long, 2.5 to 4 cm. broad, lanceolate, abruptly short-acuminate at both ends, acute, the margined petiole about 7 mm. long; thin, scarcely lustrous, sinuately serrulate, the venation not prominent, the principal secondaries strongly ascending. Racemes (in young fruit) terminal, slender, elongate, the rachis minutely downy, the pedicels 8 mm. long. A single flower exhibits lanceolate sepals 6 mm. long, the petals about equaling them.

At the junction of the Rivers Beni and Madre de Dios, *H. H. Rusby,* August 1886 (*no. 2710*).

A plant collected at Huachi, 1800 feet, *M. Cardenas,* September 4, 1921, in flower (*no. 1007*), is probably the same, though the leaves are a little broader, oblanceolate and sharply serrulate.

Calophyllum ellipticum

(Fruiting specimens.) Glabrous. Branchlets short, stout, strongly wrinkled in the dried state, dark-purple or blackish, very leafy. Petioles about 1 cm. long, stout, broadly channeled above. Blades to 1 dm. long and half as broad, nearly elliptic, both base and summit very lightly produced, obtuse, entire, thick, yellow-green and strongly shining, the midrib very strong beneath, much wrinkled, mostly thinly channeled above; pectinately veined, the secondaries extremely numerous, nearly at right angles with the midrib. Cymes few-fruited, short-peduncled, the peduncles and short pedicels slender, erect, spreading. Fruits in the dried state globose, 2 to 2.5 cm. broad, bearing style, nearly 1 mm. long, and stigma, until nearly mature. The stigma is 1 mm. broad, the margin reflexed and 4-lobed. Fruit pulpy, 1-seeded.

Lake Rogagua, 1,000 feet, *H. H. Rusby,* October 31, 1921 (*no. 1384*). "A tree on lake margin."

Rheedia Achachairu

(Fruiting specimen.) Glabrous. Branchlets slender, divaricate, fleshy, greenish, sharply angled. Petioles 1.5 cm. long, thick, dilated and clasping at the base, transversely finely many-wrinkled. Blades to 15 cm. long, 5 cm. broad, oval, with acute base and very abruptly short-pointed, acute summit, entire, thick, drying yellowish-green, the venation prominent on both surfaces, the secondaries about 40, with intermediate smaller ones. Peduncle slender, nearly 1 cm. long. Persistent sepals 2, oval, 2 mm. long, strongly reflexed. Berry globose, yellow, 2 cm. broad. Stigma black, nearly sessile, 2 mm. broad. Seed mostly 1, sometimes 2.

Rurrenabaque, 1,000 feet, *M. Cardenas,* October 12, 1921 (*no. 1256*). "Fruit edible, and known locally as 'Achachairu.' A shrub or small tree of the forest, with yellow fruit." A specimen, collected by Dr. White (*no. 1476*) appears to me to be the same, although he says that the fruit has a waxy bloom, and is bluish, possibly because immature.

Rheedia rogaguensis

(Fruiting specimen.) Glabrous. Branchlets crooked, weak. Petioles about 1.5 cm. long, channeled above. Blades to 2 dm. long and 8 or 9 cm. wide, oval, with abruptly contracted base narrowed gradually into the petiole and abruptly short-pointed summit, entire, not thick, the slender venation prominent beneath, the secondaries about 12 or 14 on each side, widely spreading and little curved except at the ends, decurrent upon the midrib. Fruits solitary, on stout peduncles nearly 1 cm| long, minutely puberulent, bearing the persistent style, which is 3 mm. long, the stigma equally broad.

Near Lake Rogagua, 1,000 feet, *H. H. Rusby,* November 4, 1921 (*no. 1611*). A small tree, with edible fruit.

Violaceae

Calceolaria appendiculata

The slender elongate spreading branchlets shortly and roughly hairy, the leaves scabrellate. Leaves opposite, the very short petioles margined, about as broad as long, the blades 4 to 7 cm. long, 2 to 3 cm. wide, ovate with blunt or rounded base and acuminate and acute summit, obscurely crenate-dentate, thin, rigid, bright-green, the slender venation lightly prominent on both sides, the secondaries 5 or 6 on each side, strongly falcate and obscurely connecting near the margin, the venation loosely reticulate. Stipules very small, subulate, thickish, deciduous. Flowers irregularly clustered in axils, subracemose, the slender pedicels at length 5 mm. long, bearing 2 subopposite minute subulate bractlets below the middle. Calyx 1.5 mm. broad and nearly as long, 2 sepals slightly smaller. Large petal nearly thrice the length of the calyx, its yellowish limb about half the length and two thirds of the breadth of its white claw, with which it is connected by a narrow base; ovate, obtuse, entire, the claw ovate, apparently without either sac or glands. Lateral petals nearly as long as the large one, inequilaterally ovate, obtuse, about as broad as the claw of the large one. Fourth and fifth petals a little shorter than the lateral, the basal portion narrowly ovate, the upper portion about as long, linear, obtuse, connected by a narrow base. Two anthers connate, their appendages about half as long as the other three.

Species peculiar in the apparent appendaging of the two petals, of which the lower portions are probably to be regarded as claws.

Huachi, 1,800 feet, *O. E. White,* September 4, 1921 (*no. 1009*).

Calceolaria biacuminata

Glabrous, the branchlets elongate, slender, widely spreading. Stipules inconspicuous, subulate. Leaves opposite, the petioles 1 mm. long, very slender, the blades 1.5 to 4 cm. long, 5 mm. to

3 cm. broad, lanceolate, acuminate and acute, mostly acute at base, shortly and bluntly serrate, very thin, of a light and bright green, the secondaries mostly 4 on each side, slender, rather crooked, strongly upcurved, the venation loose and obscure. Pedicels solitary in the axils, or occasionally 2 to 4 crowded together at the ends, 5 to 7 mm. long, filiform, with or without one or two obscure very narrow bracts below the middle. Calyx pubescent, 3 sepals 1.5 mm. long, ovate, acuminate and acute, the two others only about half as large. Large petal yellowish, 5 to 6 mm. long, the broad claw nearly twice the length of the emarginate limb, its basal, saccate portion broader than the limb. The two lateral petals about half as long as the larger one, inequilaterally ovate, the claw nearly obsolete, the fourth and fifth petals only about half as large as the lateral ones. Stamens at first coherent, with the appendages closely connivent over the stigma, at length completely separated by the growth of the ovary. Stamens 3 mm. long, the acuminate appendages a little longer than the sessile anthers, the two larger anthers glandular, but not spurred at the base. Style equaling the stamens, slightly dilated, curved.

Huachi, 3,000 feet, *H. H. Rusby,* September 21, 1923 (*no. 682*). Species very near *C. sessiliflora* O. Kuntze, but distinguished by its slender pedicels.

Calceolaria balaensis

Youngest portions minutely puberulent. Stems woody, the branches slender, rigid, widely spreading, the leaves opposite. Petioles 5 to 10 mm. long, slender, grooved above. Stipules ovate, 4 mm. long, thick and rigid, deciduous. Blades to 1 dm. long and nearly half as wide, obovate with acute base and abruptly short-pointed obtuse summit, obscurely sinuate, thin, pale-green, glabrate, the midrib and secondaries mostly impressed above, sharply prominent beneath, the secondaries 8 to 10 on each side, widely spreading, then strongly falcate-ascending, connected by very numerous crooked tertiaries. Flowers few, racemose at the ends of short branchlets, the bracts subulate, acute, about 1 mm. long. Pedicels about 2 mm. long. Sepals small, lanceolate. Largest petal 5 mm. long, the claw about a third of its length, the sac short and angular. The other petals a little shorter, narrow, the claw short and broad. Anther-appendages lanceolate, yellow, unequal, longer than the anthers, the anthers sessile, distinct.

A single specimen, Bala, *O. E. White,* without definite data (*no. 1479*).

FLACOURTIACEAE

Casearia berberoidia

Subglabrous. Branches short, stout, flexuous, gray-brown, very leafy, the leaves crowded at the ends of very short branchlets. Leaves from 1.5 cm. to 4 cm. long and two thirds or more as broad, on extremely short petioles, obovate with broadly cuneate base, or some nearly orbicular, the summit rounded or obtuse, or occasionally very slightly mucronate. Blades thickish, the revolute margin obsoletely and usually obscurely dentate. Both surfaces of a dull yellowish-green, slightly shining above, the coarsely reticulate venation prominent on both surfaces, the secondaries about 4 on each side, connecting at some distance from the margin. Flowers few, crowded at the ends of the branchlets, in the axils of imbricate bracts, which are 3 or 4 mm. long, broadly ovate, acuminate, the inflorescence minutely puberulent. Pedicels about 3 mm. long, filiform, bearing several short broad scales at the base of the calyx. Sepals 5, 4 mm. long, oblong or oblanceolate, obtuse. Filaments, staminodia and ovary densely white-pilose, the stamens and style about two thirds as long as the sepals, the style undivided, the stigma capitate. Staminodia more than half as long as the stamens, the upper portion a little broader.

Rosario Hacienda, pampas near Lake Rogagua, 1,000 feet, *H. H. Rusby,* November 4, 1921 (*no. 1652*).

Casearia albicaulis

Glabrous, excepting the minutely gray-puberulent inflorescence. Stems much branched, the branchlets short, rather stout, terete, light-gray, unarmed. Leaves to 10 cm. long, and 4 cm. wide, obovate, abruptly contracted into a petiole about 5 mm. long, and with a strongly mucronate summit, shortly and obtusely serrate-dentate, thin, the principal veins prominent beneath, the secondaries about 4 on each side, strongly ascending, the venation coarsely reticulate. Umbels sessile, many-flowered, densely bracted at the base, the bracts short, the pedicels very slender, about 5 mm. long, all gray-puberulent. Sepals 5, lanceolate, 5 mm. long. Stamens 10, at length about equaling the sepals, lightly attached to the base of the sepals. Staminodia about half as long as the stamens, oblanceolate, pilose or serrulate, unguiculate. Pistil 4 mm. long, pilose, the style tapering, continuous with the ovary, the stigma small.

On the pampas of Lake Rogagua, 1,000 feet, *H. H. Rusby,* October 28, 1921 (*no. 1366*). "A large shrub, in copses, the flowers white."

On the 4th of October, the author collected at Rurrenabaque, 1,000 feet (*no. 781*), fruiting specimens of what appears to be the same species. The leaves are somewhat larger, but in other respects the same. The sessile fruit, in the dried state, is subglobose, and 2 cm. in diameter, blackish or deep-purple and glabrous.

TURNERACEAE

Piriqueta seticarpa

Bristly-hairy, the hairs of the stem divergent and ferruginous, the upper leaf-surfaces strigose, the lower pilose. Stems a half-meter tall, sparingly branched, slender, terete, the branches erect. Petioles 5 to 6 mm. long, stout, the glands not apparent. Blades 3 to 5 cm. long, 2 to 3 cm. broad, oval-ovate with rounded base and blunt summit, lightly sinuate-dentate, the secondaries about 5 on a side, prominent beneath, strongly ascending and lightly curved. Pedicels slender, about half as long as their leaves. Calyx broadly campanulate, 5 or 6 mm. long, deeply parted, the lobes ovate, acute. Petals nearly a half longer than the calyx, the stamens only about half the length of the calyx. Ovary densely setose, chaffy, or scaly. Styles about as long as the stamens, distinct, dilated at the summit, the ends shortly and coarsely divided. Capsule 5 or 6 mm. long, and about as broad, oval, appressed, pilose.

On the pampas of Lake Rogagua, Rosario Hacienda, 1,000 feet, *O. E. White,* November 2, 1921 (*no. 1547*). Species near *P. ovata* (Bello) Urban.

Turnera muricata

Puberulent throughout except on the upper leaf-surfaces, which are sparsely and minutely strigose and somewhat harsh, though somewhat shining. Stems tall and rather stout, erect, simple, terete, purplish-red. Petioles 5 or 6 mm. long, stout, channeled above. Blades 5 to 12 cm. long, 2 to 3 cm. wide, lance-oblong, acute, obtuse or barely acute at the base, very shallowly dentate, thickish, the slender venation lightly prominent beneath, the secondaries about 7 to 9 on a side, strongly ascending, connected by an abundant strong reticulation. Pedicels very short, stout. Calyx 5 mm. long, divided nearly to the base, the segments lanceolate, mucronate, nerved, with strong midrib. Petals about as long as the calyx, thickish, obovate, strongly nerved, the nerves about 10, branched. Filaments filiform, anthers short, sagittate. Styles united nearly to the summit, stout, strongly appressed-pilose, the lobes shortly and stoutly fimbriate. Capsule 7 or 8 mm. long, and nearly as broad, globoid, dark-brown, strongly muricate.

Eastern Bolivia, without data (*no. 2009-A*).

Turnera Whitei

Glabrous, except for some sericeous hairs on and near the buds and young flowers. Much branched, the branchlets short and leafy, the internodes mostly less than a third the length of their leaves, brown, angled. Basal leaf-glands not manifest. Petioles very short, margined, the blades 2.5 to 5 cm. long, 1 to 2 cm. wide, lance-oblong, short-acuminate at both ends, acute, thickish, very sharply serrulate, the teeth slightly salient, paler beneath, the brownish venation coarsely and strongly anastomosing, prominent on both sides, especially underneath. Flowers solitary or racemosely 2 to 5 in the axils, the very slender pedicel about as long as the flower, bearing a pair of minute linear bracts about or above the middle. Calyx 5 or 6 mm. long, campanulate, yellow with five greenish ribs continued into the triangular acuminate and acute teeth, which are a third of the length of the tube. Petals a half longer than the calyx, attached above the middle of the tube, broadly spatulate. Stamens attached near the base of the tube and about equaling it, the anther ovate, with cordate base and slightly inflexed acuminate summit. Ovary conic, more than half the length of the calyx-tube, the three styles distinct, nearly twice the length of the ovary, dilated upward, the stigmas copiously fimbriate. Fruit (mature?) globose, light-brown, 5 mm. long.

Canamina, 4,000 feet, *O. E. White,* July 20, 1921 (*no. 524*). "A shrub, 4 to 6 feet high." Species related to *T. Weddelliana* Urb. & Rolfe.

PASSIFLORACEAE

Passiflora translinearis

Glabrous. Stems very slender, sharply angled or subalate, and sulcate. Stipules small, varying from slenderly setaceous to narrowly subulate. Tendrils elongate, slender, mostly flattened, at least toward the base. Petioles about 1 cm. long, slender, brown, apparently glandless. Blades about 6 mm. long and 12 cm. wide, the base slightly cordate, the summit slenderly aristate, the two lobes almost directly divaricate, scarcely 1 cm. wide, lanceolate with slightly narrowed base and mostly obtuse summit, entire, a small circular whitish gland at the junction of the central and lateral ribs. Leaf thin, the venation prominent on the lower surface, the secondaries of each lobe numerous, connecting with one another in a sinuous line near the lower margin, and, near the upper margin, with a secondary from the midrib. Peduncle 5 cm., or more long, 1-flowered, very slender. Bracts 1.5 cm. long, 3 or 4 mm. wide, oblong-oblanceolate, sharply serrate. Sepals 5, somewhat unequal, the longest 5 cm. long, 1 cm. wide, 3 or 5-nerved, lanceolate, the setose awn extending 3 or 4 mm. beyond the summit. Petals about as long as the sepals, linear, acute. Crown apparently single, the fimbriae 1 to 1.5 cm. long. Colors not noted. Gynophore nearly 3 cm. long, rather stout. Free portions of filaments 7 mm. long, stout, strongly ribbed. Anther nearly as long as the filament, broad. Styles about 4 mm. long, stout, the stigmas capitate.

In a copse of the pampa near Lake Rogagua, 1,000 feet, *H. H. Rusby,* November 4, 1921 (*no. 1619*).

Passiflora yacumensis

Petioles, leaf-veins, etc., sparsely short-pilose. Stems slender, elongate, cirrhiferous, lightly sulcate. Tendrils simple, elongate, slender. Stipules very small, lanceolate, acute, denticulate. Petioles about 1.5 cm. long, slender, narrowly channeled above, the margins minutely ciliate. Leaves to 7 cm. long and nearly as wide, truncate or subcordate at the base, 3-lobed, occasionally one or both lateral lobes wanting, the margin sharply dentate, with obtuse sinuses; middle lobe nearly two thirds of the length of the leaf, oval or oblanceolate, the lateral lobes about half as long, lanceolate, moderately spreading, all the lobes acute, the sinuses obtuse; texture somewhat rigid, though thin, 5-nerved, the secondaries of the middle lobe about 5 or 6 on each side, the venation strongly anastomosing, prominent on both sides. Peduncle about 4 cm. long, finely angled or sulcate. Bracts 3, about 1.5 cm. long, narrowly lanceolate, acute, unequally serrate-dentate, green, thin. Sepals 5, 4 cm. long, 8 mm. wide at the base, lance-linear, apparently obtuse, the awn 2 mm. long, filiform. Petals 5, 3 cm. long, 3 or 4 mm. wide at the base, linear, obtuse, very thin. Gynophore 2 to 2.5 cm. long. Free portions of filaments 3 or 4 mm. long, slender. Anthers 5 mm. long. Styles strongly recurved, 6 mm. long, broader above. Stigmas 2 or 3 mm. long, inequilaterally oval, slightly mucronate. Fimbriae of the crown very numerous, slender, about 1 cm. long, apparently 2-seriate. So far as I can judge from my one imperfect flower, there is an inner crown, a little shorter than the outer, which is multi-laciniate nearly to the base. Colors of flower unknown.

Santa Ana de Yacuma, 700 feet, *M. Cardenas,* March 5, 1922 (*no. 21 special*).

Passiflora nigradenia

Glabrous. Stems high-climbing, the branchlets stout, terete. Petioles to 4 cm. long, stout, strongly channeled, bearing 2 large black sessile glands just above the middle. Mature blades to 2 dm. long and 8 cm. broad, oblong or slightly broader below, with rounded or subtruncate base, the summit very abruptly contracted into a short acute point, the margin entire, thinly revolute; coriaceous, the upper surface slightly shining, the slender venation sharply prominent beneath, the secondaries 10 or 12 on each side, falcate-ascending, connected by a coarse anastomosis of the tertiaries. Flowers racemose, the racemes sometimes bearing as many as 10 flowers, and shortly peduncled. Pedicels 3 cm. long, terete. Bracts borne close to the flower, sessile, nearly 3 cm. long and half as wide, ovate or oval, obtuse, bearing a pair of marginal glands close to the summit. Basal annulus of calyx slightly umbilicate, 1.5 cm. broad, sharply contracted into the calyx-tube, which is 1 cm. long. Calyx-lobes 3 cm. long, 12 mm. broad, lance-oblong, acutish, fleshy. Corolla two thirds the length of the calyx, the petals thin, about 1 cm. broad, lance-ovate, obtuse. Bases of petals and calyx-lobes bearing on their inner face a rather sparse circle of erect fleshy setae about 1 cm. long, of whitish color, transversely barred with black. Ligules of the crown very numerous and densely massed, about as long as the calyx, 3 or 4 mm. wide, flat, obtuse, colored like the setae above described, their connate portion about a fourth of the total length, and shortly fringed upon its inner surface. Gynostegium stout, 1.5 to 2 cm. long. Free portion of filaments about 1 cm. long, erect, strongly flattened. Anthers 1 cm. long, oblong, attached below the middle, becoming reflexed and inverted. Ovary shortly stipitate above the filaments, ellipsoidal, 7 or 8 mm. long. Style thick, half as long as the ovary, the two large globose stigmas coherent. Stipe of fruit 2 cm. long above the bracts, stout, annulate. Fruit nearly 1 dm. long, 8 cm. broad, regularly ellipsoid but umbilicate at the base, glabrous, edible, the epicarp soft.

Rurrenabaque, 1,000 feet, *H. H. Rusby,* December 1921 (without number). Species very near *P. riparia* Mart. for which it was at first mistaken. It appears to produce the largest edible fruit known in the genus, and one that is highly esteemed by the natives of the region where it grows.

PAPAYACEAE

JACARATIA BOLIVIANA

This species was described (Rusby, Bull. N. Y. Bot. Gard. **8**: 107. 1912) from specimens collected by Mr. R. S. Williams at Charapampa, Bolivia, in late September 1901. These specimens, staminate only, were in flower, and no information regarding the fruit was obtained. In late November, 1921, the species was again collected (*no. 1877*) by Mr. Martin Cardenas, a member of the Mulford Exploration party, at Rurrenabaque, at a somewhat lower altitude, the specimens bearing fruit nearly, if not quite mature. In the young state, the fruit is obovoid, with tapering base and acutish summit. As it approaches maturity, it fills out at both base and summit, and approaches the ellipsoidal form, although the base remains a little narrower than the summit, even in my largest specimen. This, in the pressed and dried state, is about 8 cm. long, by nearly 4 cm. wide. It bears a short annulate stem, nearly as thick as long, and the subsessile black stigma. The color of the fruit is light-yellow, although it may be darker at full maturity. It is known locally as *"Papaya del Monte,"* or Wild Papaw, and is said to be edible.

COMBRETACEAE

Combretum vernicosum

Young branchlets and inflorescence and lower leaf-surfaces closely puberulent and slightly rough, the upper leaf-surfaces strongly lustrous. Branchlets rather stout, terete, very leafy, the internodes less than half the length of their leaves. Petioles 5 to 7 mm. long, stout, margined. Blades to 1 dm. long and half as wide, ovate with base very abruptly contracted into the petiole, very abruptly and shortly acuminate and acute, entire, thick, deep-green, the slender venation prominent beneath, the secondaries about 6 or 8 on each side, strongly falcate-ascending, connected by the tertiaries, the finer venation finely anastomosing. Panicles axilliary and terminal, shortly peduncled, the flowers densely spicate on the branches, the racemes, in flower, 5 mm. wide. Calyx-tube less than 1 mm. long, the mature bud about as broad as the length of the tube and only half as long. Open flower about 2 mm. broad. Sepals 4, broadly oval, concave, thickish, a little more than half the length of the petals, which are obovate and lightly denticulate. Stamens 8, slightly longer than the sepals.

Along the Rio Ibon, 500 feet, *O. E. White,* February 9, 1922 (*no. 2374*).

MYRTACEAE

Calycorectes macrocalyx

Glabrous. Branchlets slender, more or less quadrangular. Leaves divaricate, the petioles about 1 cm. long, stout, narrowly channeled above. Blades to 12 cm. or more long, and nearly half as broad, oval with obtuse or rounded base and a very short, broad, obtuse acumination, thickish, the margin revolute, pale-green, the midrib channeled above, prominent beneath, the filiform secondaries about 12, with some smaller ones intervening, widely spreading, and looped together a little way from the margin. Peduncles (always ?) supra-axillary, 1-flowered, opposite, subtended by nodiform or gland-like small bracts, slender, about 2 cm. long, more or less angled, slightly thickened upward. Calyx 4-parted nearly to the base, the segments nearly 2 cm. long by 5 mm. wide, somewhat unguiculate, the unguis dark or blackish, about half as wide as the limb, which is lance-ovate, blunt, green and leaf-like, thickish, very veiny, the base very abruptly contracted into the unguis. Petals only about half as long as the calyx and about equaling the numerous stamens. Anthers whitish, with yellow connective, about as long as broad, versatile. Disk broad, blackish, the thin margin recurved. Style setaceous, the summit recurved.

Along the Bopi River, 3,000 feet, *H. H. Rusby,* September 12, 1921 (*no. 666*). "On a cliff of the river-bank, in partial shade. Stamens white, turning yellow with age."

MELASTOMATACEAE

TIBOUCHINA MEMBRANIFOLIA Cogn. Bull. Torrey Club **23**: 17. 1896.

This species, heretofore known only in flower, appears to have been collected in mature fruit at Canamina, 4,000 feet, *O. E. White,* July 20, 1921 (*no. 278*). In characters of stem, leaf and indumentum, the specimens are indistinguishable from the type, but they show a notable development in the fruiting inflorescence. The peduncles are elongated to 5 and 6 cm., with corresponding elongation of their branches, while some of the pedicels are 1 cm. long. The following is a description of the fruits.

Calyx-tube about 7 mm. long, 4 mm. wide, campanulate, with the mouth slightly contracted, light-brown, strongly 10-ribbed, the ribs broad and obtuse. Limb short, the teeth about a third as long as the tube, triangular, acute, erect-spreading.

Brachyotum setosum Gleason

Stem suffruticose or herbaceous, 15–60 cm. high, freely branched, minutely sordid-setulose and hirsute at the nodes when young, glabrous with age; petioles slender, 3–5 mm. long, closely and minutely appressed-setulose; leaf-blades thick and firm, ovate-elliptic, 12–25 mm. long by half as wide, rounded at both ends, entire, sometimes slightly revolute, 3-nerved, above with 4 longitudinal bands of sparse, stout, appressed, yellow, conic-subulate setae 0.7–1 mm. long and 0.1–0.2 mm. in diameter, otherwise glabrous, beneath yellow-green, sparsely and finely setulose on the veins; flowers solitary or in threes, 5-merous; pedicels stout, 1 cm. long, jointed at the middle, densely appressed-setulose; hypanthium reddish, broadly campanulate, 6 mm. long, closely and finely appressed-setulose with hairs 0.2–0.3 mm. long; sepals deltoid, 4 mm. long and wide, contiguous at the base, abruptly narrowed from below the middle to an acuminate apex, strongly thickened and densely setulose along the center, the lateral basal margins thin, pale, membranous, glabrous, and setulose-ciliate; petals purple, broadly ovate-rotund, 12 mm. long and broad, inequilateral, obtuse, minutely ciliate, somewhat fleshy, reticulate-veined; anthers linear-oblong, straight, 5 mm. long, 1.4 mm. wide, the 2 basal appendages short, ovate, blunt, 0.3 mm. long; ovary ovoid, strongly 10-ribbed, 5 mm. long, 4 mm. in diameter, densely setulose at the apex, the ribs with a short, sharp tubercle at the center, the 5 alternate lobes prolonged beyond the ovary into erect, fleshy, oblong, rounded lobes, 2 mm. long by 0.8 mm. wide, setulose, especially at the apex, with flat erect hairs 0.6–0.8 mm. long; style stout, 1 cm. long, 0.9 mm. in diameter at base, gradually tapering to the blunt stigma.

Pongo de Quime, about 67° W., 17° S., *O. E. White,* 11,500 feet, July 12, 1921 (*no. 151*).

B. setosum is a member of the section *Adesmiae*, and related to species 25 to 28 of Cogniaux' Monograph. It is distinguished from any of these by the peculiar setose pubescence of the upper leaf-surface.

Maieta (?) hispida

Bristly throughout with stout divergent hairs, the leaves ciliate with the same. Stems slender, terete, flexuous . Leaves alternate, one of each pair being obsolete or represented by a mere vestige, or by a small vesicle, or rarely by a small normal leaf. Petioles 1 to 1.5 cm. long, sometimes twisted, rarely with a small vesicle at its base. Leaves 10 to 15 cm. long, 4 to 6 cm. broad, lance-oblong, the summit abruptly contracted into a short, narrow and very acute acumination, the base contracted and then rounded and bearing on its upper surface a green or greenish vesicle with rounded base and of variable form. Leaf finely and irregularly dentate, the teeth triangular and acute and terminating in a bristly hair. Leaf thin, bright-green, much paler beneath, with two pair of nerves starting from near the base, the lower pair slender and terminating in the margin near the summit, the upper joining the midrib near the summit, all prominent on the lower surface and connected by a moderate number of nearly straight, very slender tertiaries, all the venation more or less bristly pilose, the upper portion finely and rather sparsely strigose. Flowers (not seen) mostly one or two in the axil, and usually one upon the opposite side, where a leaf should be, and sometimes borne similarly along slender stems where the leaves are wholly or mostly wanting. Fruits sessile, or nearly so, recurved, each subtended by about 3 closely clasping broadly ovate, carinate and mucronate bracts, half as long as the calyx, the tube of which is campanulate with slightly contracted throat, frequently inequilateral, about 7 mm. long and 4 mm. broad, strongly hispid, or tuberculate with the enlarged bases of the fallen hairs. Calyx-limb 5 toothed, the united portion shorter than the teeth, wider than the tube, crateriform or short-campanulate, bearing a thickened ring at the base on the inside, the teeth broadly triangular, acutely cuspidate, the cusp strongly reflexed.

Tumapasa, 1,500 feet, *O. E. White,* December 8, 1921 (*no. 1839*).

Although this species is referred doubtfully to *Maieta,* I have no doubt that it is generically distinct therefrom. In *Maieta,* the calyx is not extended beyond the capsule, whereas in this species it is markedly extended, in a dilated form, and with a peculiar annulus on the inside. These characters, especially in this family, have a generic significance. In some ways, the plant is nearer to the genus *Microphysa* than to *Maieta,* but is sufficiently distinct from that also. In the absence of flowers, I am not disposed to propose a new genus.

ONAGRACEAE

Jussieua yacumensis

Densely and minutely puberulent. Stems sharply angled or subulate, at least above. Leaves sessile, very variable in form, from narrowly lance-linear to oval or oblong, with obtuse base and obtuse or acute summit, from 4 cm. long and 3 mm. wide to 4 cm. long and nearly 2 cm. wide; the midrib very stout and prominent beneath, slightly so above, the secondaries about 10 on each side, very prominent beneath, strongly ascending, the basal portion strongly curved, the margin slightly thickened and revolute. Pedicels solitary in the axils, elongate in the fruit, at length nearly 1.5 cm. long, slender. Calyx-tube, in flower, 5 mm. long, 2 mm. wide, short-infundibular, obtusely 4-angled, the lobes nearly a half longer than the tube, lance-linear, acuminate, the midrib very strong, in fruit 3-ribbed with smaller intermediate ones. Petals nearly twice the length of the calyx-lobes. Partly mature fruit broadly infundibular, with 4 strong and 4 lighter ribs.

Santa Ana del Yacuma, 800 feet, *Martin Cardenas,* March 5, 1922 (*no. 18, special*). "Plant 2 to 4 feet high, along roadsides, the flowers yellow, the fruits very small." Also collected on the pampas near Lake Rogagua, 1,000 feet *H. H. Rusby,* November 3, 1921 (*no. 1427*). Also from Buena Vista, Santa Cruz, Bolivia, February 16, 1921, *Steinbach 5326.*

This species is closely related to the widely distributed and extremely variable *J. nervosa* Poir., but its slender habit, smaller size and flowering appear to exclude it.

J. marginata Rusby now appears to me to be an extreme form of *J. nervosa* Poir. with cordate leaves, having lustrous upper surfaces, that seems to represent this species on the southern pampas.

Jussieua biacuminata

Glabrous. Stems aquatic, a meter high, erect, sparingly branched, the branches erect, the base and lower portion of stem much spongy-thickened. Leaves sessile, very unequal, to 1.5 dm. long and 4 mm. wide, sometimes much larger at the base, acuminate and acute at both ends, entire, thick and somewhat fleshy, the midrib very thick and prominent. Pedicels filiform, 5 or 6 mm. long, usually bearing one or two subulate bracts near the summit. Calyx-tube infundibular, a little more than half the length of the pedicel. Calyx-lobes in anthesis widely spreading, 3 or 4 mm. long, ovate, acuminate and acute. Petals white, little exceeding the sepals. Fruiting pedicel not elongate, the capsule 2.5 cm. long, 3 mm. broad, linear, straight or curved, 8-nerved, the calyx-lobes persistent or at length deciduous.

In swamps about Lake Rogagua, 1,000 feet, *H. H. Rusby,* November 3, 1921 (*no. 1601*). "Growing in water, 3 or 4 feet high, the flower white."

Fuchsia filipes

Glabrous, the numerous branchlets elongated and slender. Petioles very slender, 3 to 5 mm. long, the blades 2 to 4 cm. long, 5 to 10 mm. broad, lanceolate and mostly a little inequilateral, regularly acuminate at both ends, more so at the summit, subentire, thin and herbaceous, deep-green above, pale beneath, the secondaries 4 or 5 on a side, slender, strongly ascending, the smaller venation obscure. Flowers mostly one or two in each axil, the filiform pedicels about 1 cm. long, up to 2.5 cm. in fruit. Flowers scarlet, short-pilose, 2 cm. long, slender, the linear-oblong ovary about one sixth, the corolla-tube nearly half of the length, the latter narrow-infundibular, sharply constricted above the ovary, the lanceolate calyx-lobes at length spreading, the margins increasingly involute toward the summit, where they become closed, with a black tip. Petals ovate, very thin, paler than the calyx-lobes, or yellowish, and about two thirds of their length. Longer stamens about equaling the calyx-lobes, the others a fourth shorter, the filaments filiform, the oval anthers 2 mm. long, attached below the middle. Style about equaling the stamens, slightly thicker than the filaments, clavate at the summit, the short, broad stigma 2-grooved. Fruit ellipsoid, 1 cm. long, 6 or 7 mm. broad, 8-sulcate, transversely grooved. Seeds numerous, brown, inequilaterally pyriform or lightly falcate, about 1 mm. long.

Pulcheri, 10,000 feet, *O. E. White,* July 15, 1921 (*no. 232*). "Shrub 2 to 8 feet high, in rain-forest, the flowers cardinal-red and yellow."

Theophrastaceae

Clavija Cardenasii

Lower leaf-surfaces minutely and sparsely puberulent. Stem erect, simple, to 2 m. high, blackish-gray and finely many-wrinkled in drying. Leaves to 5 dm. long and 12 cm. wide, oblanceolate, the base very gradually tapering into a narrowly winged stout petiole, the summit not seen, minutely and sparsely toothed, the teeth salient and acute, the midrib lightly channeled above, very prominent and terete beneath, the venation prominent on both sides, the secondaries coarsely, strongly and irregularly anastomosing, as does the finer venation. Racemes mostly solitary and simple, about half the length of their leaves, or less, very slender, loosely flowered, irregularly peduncled. Bracts shorter than their pedicels, subulate, acute, thickish, not or little spreading. Pedicels about 1.5 mm. long, thickened upward. Calyx 2 to 3 mm. broad, and not so long, the turbinate tube gradually narrowed into the pedicel, longer than the 5 broadly rounded, whitish, minutely mucronate lobes, loosely enclosing the bud. Corolla scarlet or vermilion, fleshy, 8 to 10 mm. broad, the campanulate tube very short, the lobes subrotund. Staminodia thick and fleshy, broader than long, their breadth about half that of the white stigma, which is 1.5 mm. broad and 10- to 12-dentate or crenate. Staminate flower not present in my specimen.

Rurrenabaque, 1,000 feet, *Martin Cardenas,* November 25, 1921 (*no. 1178*).

Myrsinaceae

Cybianthus glauca

(Fruiting specimen.) Glabrous. Stem terete, apparently simple. Leaves 1 to 2 dm. long, 6 to 9 cm. wide, oblanceolate, sessile, but narrowed into a short petiole-like base, which is channeled by the incurved wings, obtusish or barely acute, entire, pale or glaucous-green above, very pale underneath, the midrib narrowly channeled above, very prominent and subcarinate beneath, the innumerable secondaries very slender, widely spreading, becoming falcate and anastomosing near the margin. Racemes sessile, very short and few-fruited, the calyx persisting after the fall of the fruit, on slender pedicels less than half the length of the fruit, deeply 5-lobed, the lobes oblong, obtuse, about 1.5 mm. long. Fruit globose or slightly depressed, 6 or 7 mm. broad, red, lightly and sparsely tuberculate.

Specimens purchased from a boy at Rurrenabaque, 1,000 feet, October 8, 1921 (*no. 1581*).

SAPOTACEAE

Lucuma polycarpa

(Fruiting specimen.) Glabrous. Branchlets stout, very leafy. Petioles to 2.5 cm. long, stout, channeled on the upper surface. Blades to 12 cm. long, 4 cm. wide, oblong, with base gradually contracted into the petiole, and blunt summit, entire, with revolute margin, thick and coriaceous, the upper surface lucid, the venation prominent beneath, the secondaries 18 or 20 on each side, with smaller intermediate ones, the venation strongly and finely anastomosing . Fruits densely spiked along the thick branchlets, subsessile, the branch strongly nodose where the fruits have fallen. Persistent calyx appressed, the sepals subrotund, 4 or 5 mm. broad. Fruit depressed-globose, 3.5 cm. broad, glabrous, the summit umbilicate. Seeds about 4, oval, lightly compressed, 1.5 cm. long, black and shining.

Collection data lost, but probably from the vicinity of Rurrenabaque. Fruit edible.

Sideroxylon bolivianum

(Fruiting specimen.) Glabrous. Branchlets stout, leafy. Petioles 1.5 to 2 cm. long, slightly decurrent upon the stem, narrowly channeled above by the incurved margins, which are continuous with those of the blade. Blades to 1.5 dm. long by nearly 6 cm. wide, oblanceolate or obovate with acuminate base and rounded, mostly slightly apiculate summit, entire, thick, pale or light-green on both surfaces, the midrib stout and rounded on the lower surface, mostly channeled above, the principal secondaries 15 to 18 on each side, with many smaller ones, spreading widely, little curved except at the ends, very slender, the slender venation strongly anastomosing. Fruits crowded below the leaves, sessile, globose or slightly broader than long, 2 to 2.5 cm. broad in the dried state, very fleshy, mostly 4- or 5-seeded. Seeds about 1 cm. long, two thirds as broad, brown, strongly shining, nearly ellipsoid, the hilum oblong, extending nearly the entire length.

Huachi, 3,000 feet, *H. H. Rusby,* August 22, 1921 (*no. 691*). "A large forest tree with abundant milky juice. Fruit yellow, sweet and good, but depositing an objectionable amount of gummy resin upon the teeth."

Chrysophyllum ovale

(Fruiting specimen). Glabrous. Branchlets slender, gray, coarsely angled, coarsely pitted with scars, leafy, the leaves mostly larger at the ends. Petioles, including the narrowed leaf-base, with which they are continuous, about 1 cm. long, flat, margined. Blades very unequal, from 3 to 8 cm. long, and 1.5 to 3 cm. wide, oblong or oval, very abruptly contracted into a short point at each end, that at the summit mostly oblique or twisted, mostly obtuse; entire, thickish, shining, the midrib underneath rounded and strong, channeled above, the principal secondaries 12 to 15 on each side, with numerous smaller ones, the smaller venation obscure. Pedicel of the fruit about 4 mm. long, slender. Persistent calyx lobes reflexed, about 1 mm. long, ovate, obtuse. Dried fruit globose or a little longer than broad, about 1.5 cm. broad, fleshy, mostly 1-seeded in my specimens, the seed 1 cm. or more long and more than half as broad, ellipsoid, light-brown, somewhat shining, the gray hilum taking up two thirds of the length and half the circumference of the seed.

Esperanza Falls, 500 feet, *O. E. White,* February 1921 (*no. 1384-A*).

EBENACEAE

Diospyros boliviana

(Fruiting specimen, bearing a single leaf.) Glabrous, with the exception of the calyx. Branchlets numerous, rather stout, light-gray. Petiole 7 mm. long, stout, flattened or shallowly channeled on the upper surface. Blade 6 cm. long, 4.5 cm. broad, obovate, with acute base and rounded summit, entire, coriaceous, shining above, paler beneath, with the slender venation prominent, the secondaries about 5 on each side, reddish, branching, the ends strongly upcurved and connecting at some distance from the margin. Fruits axillary, solitary, very short-peduncled. Calyx coriaceous, brown or purple, the tube crateriform, tomentellate, 1.5 cm. broad, the limb about 5 mm. wide, 3-lobed, the lobes somewhat spreading, but mostly concave, often irregularly notched at the summit, strongly reticulate-veined on the outer surface. Berry about 1.5 cm. broad, depressed-globose, smooth and shining, the summit lightly umbilicate and bearing the short black style-base. Berry 6-celled, the cells 1-seeded. Seeds elliptic-oblong, nearly 1 cm. long and half as broad.

Without data as to locality or date, but probably on the lower Beni River.

Gentianaceae

Gentiana longipes

Young stems, calyx, etc., minutely scabrellate. Stems several to many, simple or sparingly branched, ascending, weak, very slender, to about 1 dm. high, 4-angled or with 4 very narrow green wings. Leaves few, sessile, 8 to 12 mm. long by nearly 2 mm. wide, lance-linear, obtuse. Flowers solitary at the ends of the stems, on long slender naked branches, blue or bluish, to 3 cm. long, erect. Calyx-tube campanulate, at length 4 mm. long and 5 mm. broad, bearing 8 green nerves or ribs, 4 stronger than the others, the calyx-teeth about twice as long as the tube, lanceolate, long and regularly acuminate, acute, ribbed or keeled. Corolla 1.5 cm. long, parted nearly to the base, infundibular, the lobes oblanceolate. Stamens 3 or 4 mm. long, the filaments slender, nearly as long as the anthers, which are lanceolate and sagittate, with acuminate basal lobes and acute summit. Ovary linear-oblong, more than 1 cm. long and 2 mm. broad, the stigma sessile, capitate, 2-lobed. Pod 2 cm. long, 5 mm. wide, oblong, or slightly wider toward the top.

Chapare, near Cochabamba, 12,000 feet, *M. Cardenas,* March 28, 1922 (*no. 76 special*). "A rare herb, with bluish flowers, growing in Azorella formation."

Tetragonanthus Whitei

(Fruiting specimens). Glabrous. Stems tufted, 5 to 10 cm. tall, erect, rather stout, branching only at the summit, sometimes reddish below, more or less winged above, the wings green.

Root-leaves to 2 or 3 cm. long, including the long petiole, widely spreading, prostrate or ascending, the blade 4 to 10 mm. or more long, the base tapering into the petiole, thickish, entire, obtuse. Stem-leaves few or none, sessile, lanceolate, to 1.5 or 2 cm. long, yellowish-green, with a stout green midrib. Flowers solitary at the ends of the stout branchlets, all parts persistent. Calyx-lobes 5 mm. long, nearly 2 mm. wide, oblanceolate or spatulate with rounded summit, erect. Corolla-tubes 5 mm. long, erect, lanceolate, acutish, the spur of equal length, completely reflexed. Stamens nearly 2 mm. long, erect, filament and anther about equal, or the filament longer, the filament slender, somewhat flattened, the anther oval, extrorse, attached at about the middle. Pod nearly 1 cm. long, 4 mm. broad, ovoid, acute, 2-valved.

Pongo de Quime, 11,500 feet, *O. E. White,* July 11, 1921 (*no. 178*). "Herb 4 to 6 inches high, in sandy loam, by water edge, in boggy ground. Flowers greenish to yellowish. Rare."

Chelonanthus Whitei

Glabrous, the stems 1 to 2 meters high, erect, terete, simple, or nearly so, the inflorescence successively bifurcating, the branches approximate and erect, many-flowered. Leaves 5 to 9 cm. long by 3 to 5 cm. broad, obovate, entire, acute, gradually narrowed into a petiole-like base, very thin, a pair of strong, coarse, strongly ascending secondaries arising some distance above the base, with a variable number of smaller ones above, the remaining venation weak and scanty. Pedicels stout, shorter than the calyx, reflexed in fruit. Calyx cupulate or campanulate, nearly 1 cm. long and nearly as broad, as pressed, deeply 5-lobed, thick and fleshy, the lobes subequal, broadly ovate, obtuse, with a very short, stout acute terminal point. Corolla abruptly expanded on emerging from the calyx into a campanulate, strongly two-lipped limb, the shorter lip extending 1.3 cm. beyond the calyx, its margin sharply reflexed, the longer extending more than 2 cm. beyond the calyx, its middle lobe nearly twice the length of the lateral. Stamens and style slightly exserted, the anthers broad, minutely muticous, the style stout, its linear branches a fifth of its total length.

Ixiamas, 800 feet, *O. E. White,* December 16, 1921, (*no. 1195*). "Growing in full sunshine, on open pampa, the flowers greenish-yellow." Species near *C. acutangula* (R. & P.) Gilg, but the stem not angled, the calyx larger and the corolla of different form.

APOCYNACEAE

Aspidosperma rigida

(Fruiting specimen.) Lower leaf-surfaces minutely papillose. Branchlets rigid, flexuous, irregularly and sharply angled, sharply nodose at the scars of the fallen leaves. Leaves to 1.5 dm. long and 5 cm. broad, oblong or oval, very abruptly contracted into a stout petiole about 5 mm. long, and similarly contracted at the summit into a short acute acumination, entire, thick and rigid, of a dull pale-green color, the midrib narrowly and sharply grooved above, strongly prominent beneath, the secondaries 10 or 12 on each side, not prominent, slender, widely spreading and lightly curved. Panicle terminating a branchlet of the preceding year, lax, in the type specimen bearing only two mature fruits but with numerous scars where other fruits or flowers have fallen. Fruits monocarpellary, stipitate, blackish. Stipe of the larger one 3 mm. long and broad, the body nearly 3 cm. long and broad, its dorsal outline about two thirds of a circle, the ventral margin straight or nearly so, and 2 cm. long. Margin of fruit not thickened, the surface finely papillose and wrinkled. Seeds to 2.5 cm. long, and 2 cm. broad, oval with one edge less curved, the body brown, 17 mm. long by 13 mm. broad, entirely surrounded by the blackish wing, of unequal breadth and bearing an intramarginal line, the margin entire.

In the Bopi River Valley, 3,000 feet, *H. H. Rusby,* September 12, 1921 (*no. 593*). "A shrub, in the edge of the forest."

Aspidosperma sp.

These interesting specimens consist of mature fruits, with their contained seeds, picked up beneath the trees, and seedling plants, with cotyledons attached. Some young and very tender leaves are present. Since part of their leaves are attached to the seedlings, it is probable that all of them have so originated.

Mature carpels woody, stipitate, the stipe 3 or 4 cm. long, nearly 1 cm. thick, the valves to 1.4 dm. long, 1.1 dm. broad, the dorsal outline nearly semicircular, the ventral moderately curved, the style-scar below the summit, connected with the summit of the dorsal curve by a straight or slightly concave line 2.5 or 3 cm. long. Carpel strongly flattened, with the entire margin strongly and broadly thickened, the surface very densely and finely tomentellate and flabellately many-nerved, blackish or deep-chocolate-colored in the dried state. Seed, including the wing, to 8 cm. broad, nearly circular, the body 4 cm. broad, the wing lacinately cleft. Entire surface of seed and wing of pale-brown color, the semicircular hilum blackish-brown, 1.5 cm. broad. The leaves are alternate, or the first two opposite, with obtuse base and very shortly produced obtuse summit. Secondaries 8 to 10 on each side, ascending and crooked.

Tumapasa, 1,500 feet, *Martin Cardenas,* December 9, 1921 (*no. 1985*). "A large tree, with very hard wood, in forest. Local name 'Mete' (pronounced May-tay)." Species obviously related to *A. Pohliana* Muell. Arg. Probably undescribed, although it may be a named species of which the fruit is heretofore unknown.

Tabernaemontana unguiculata

Finely tomentellate. Branchlets short, rather stout, roughened with the prominent leaf-scars and interpetiolar lines, leafy at the ends. Petioles 1 cm. or less long, slender, abruptly dilated at the base. Blades to 1 dm. long and a third to a half as wide, oblanceolate, gradually tapering into the petiole, abruptly acuminate and acute at the summit, entire, very thin, deep-green and nearly glabrous above, gray-tomentellate beneath, the midrib finely channeled above, prominent beneath, the secondaries about 12 on each side, widely spreading and strongly falcate toward the ends, the finer venation obscure. Cymes in the upper axils, few-flowered, short-peduncled. Bractlets 1 to 2 mm. long, ovate, acute, closely appressed. Pedicels about 5 mm. long, slightly angled upward. Calyx deeply parted, the tube turbinate, the lobes about 2 mm. long, ovate, obtusish, the prominent midrib green, the margins whitish. Corolla-tube 15 mm. long, very slender, narrowed upward, the limb nearly 2 cm. broad, 5-parted, the lobes broadly ovate, with narrow, lightly keeled base, the margin crispate. Glands of the calyx small. Disk not seen. Ovaries widely separated and filiform, the styles separate for some distance at the base, the entire pistil about 5 mm. long. Stigma relatively large, annulate. Stamens not seen. Immature follicle two thirds as long as broad, oval, obtuse and nearly elliptic, thick, densely short-tuberculate. Apparently only one follicle develops.

Huachi, 3,000 feet, *O. E. White,* August 21, 1921 (*no. 461*). "A tree, 15 feet high, in forest shade, the flowers white and fragrant." Also collected on the Iniquia River, 2,500 feet, *H. H.*

Rusby, September 21, 1921 (*no. 753*). Species near *T. crispiflora* K. Schum.

Echites rigida

Glabrous. Stems rather stout, reddish-purple. Petioles 1 to 1.5 cm. long, dilated at the base, the interpetiolar lines strong. Blades to 9 cm. long and 4 cm. wide, subelliptic, minutely mucronate, thick, deep-green, the midrib prominent beneath, the slender secondaries about 10 or 12 on each side, widely spreading, straight, with the ends upcurved, connected by the tertiaries. Cymes short-peduncled, bifurcated, densely flowered, the rachis strongly nodose. Pedicels about 1.5 cm. long, upwardly thickened and angled. Calyx about 5 mm. long, divided about midway, the tube cupulate, thickish like the ovate obtuse lobes. Corolla-tube about 12 mm. long, rather stout, sharply constricted at about the middle, the limb rotate, 2 cm. broad, the lobes broad and rounded. Calyx-tube lined with a ring of 10 broadly ovate green scales which are about twice the height of the 5-lobed black disk, the latter nearly equaling the ovaries. Corolla naked within. Stamens attached at the constriction of the tube, the anthers sessile, 4 mm. long, slightly sagittate.

Rurrenabaque, 1,000 feet, *M. Cardenas,* January 25, 1921 (*no. 2042*). Species very near *E. Sanctae-crucis* S. Moore.

Echites bracteosa

Scabrous, with the exception of the lower leaf-surfaces, which are softly tomentellate between the principal veins. Branches slender, climbing, terete, reddish. Petioles 5 to 10 mm. long, broad. Blades 7 to 10 cm. long, 3 to 5 cm. broad, oval or ovate, with very slightly cordate base and shortly acuminate and very acute summit, entire, thickish, the upper surface deep-green, with the venation mostly impressed, scabrous, the lower surface softly tomentellate, gray-brown, the slender reddish midrib and secondaries lightly prominent, the latter about 8 on each side, ascending and connecting near the margin. Raceme simple, stoutly peduncled, densely flowered, becoming secund, the pedicels articulated into slightly cup-shaped depressions. Young buds concealed by the imbricate bracts, which are about 1.5 cm. long, narrowly lanceolate and attenuate. Pedicels extremely short. Calyx-tube 2 mm. broad and not so long, campanulate with slightly contracted summit, the teeth about 2 mm. long, subulate, attenuate. Corolla-tube proper scarcely as long as the calyx, the cylindric throat 3 cm. or more long, curved, the middle third gradually contracted, then suddenly distended by the anthers and again contracted. Open flowers not seen, the lobes in the mature bud 7 mm. long. Dissection material wanting. Young follicles nearly 2 dm. long, slender, moniliform.

Ixiamas, 800 feet, *O. E. White,* December 11, 1921 (*no. 1142*). "A slender, woody vine in marshes. Flowers yellow, lined faintly with red on corolla-lobes." This plant is closely related to *Echites* or *Mandevilla boliviana,* and also *M. tenuicarpa.* It is probable that none of the three belongs to either of these genera. The heterogeneous aggregation of species now grouped in "*Echites*" undoubtedly comprises several good genera, and any reference of the species of the *E. boliviana* group to either genus must be regarded as provisional.

Dipladenia rotundifolia

Tomentose throughout. Stems simple, erect, to nearly 1 meter high, terete, leafy, the upper and lower leaves smaller, the base bearing a few roundish, scale-like leaves. Petioles almost wanting. Largest blades about 8 cm. long, rotund, subcordate, the summit usually very shortly mucronate, often emarginate; more or less ferruginous beneath, where the midrib is prominent. Secondaries 10 or 12 on each side, strongly falcate, more or less connected by crooked tertiaries. Flowers few, in a long-peduncled terminal raceme. Bracts very small, subulate, rigid. Pedicel stout, erect, terete or angled above, about 1 cm. long. Calyx deeply parted, the spreading rigid lobes about 5 or 6 cm. long, ovate, the strong midrib terminating in an awn-like summit. Corolla rose-colored, the tube 1 cm. long, 3 mm. broad, slightly dilated above, the throat infundibular, 3 cm. long, 1 cm. broad at the middle, the limb 4 or 5 cm. broad, the 5 lobes broad and rounded. Dissection material wanting.

Ixiamas, 800 feet, *O. E. White,* December 16, 1921 (*no. 1144*). "An herb, 3 to 4 feet high, with milky juice, growing in full sunshine, on pampas, in sandy loam. Not common." Species very near *D. tetradenia* Rusby.

Rhabdadenia mamorensis

Glabrous. Stems slender, strongly twining. Petioles slender, 5 to 10 mm. long. Blades to 1 dm. long and 2 cm. wide, mostly divaricate. Base cordate, with short and narrow sinus and obtuse and slightly incurved lobes. Summit long and finely acuminate and acute. Midrib rather stout, prominent on both sides, the secondaries slender, about 15 on each side, widely spreading, connected at some distance from the margin, the remaining venation loosely anastomosing. Peduncles axillary, mostly about half as long as their leaves, mostly one- or two-flowered. Sepals nearly distinct, erect, 8 or 9 mm. long, 1 to 1.5 mm. wide, lanceolate, attenuate, the midrib rather stout. Corolla rose-purple, 6 to 7 cm. long, the tube a little longer than the calyx and 1 to 1.5 mm. wide, abruptly dilated into the throat, which is 1 cm. broad and gradually expands into the limb, which is campanulate and 3 or 4 cm. broad at the mouth. Anthers sessile, attached at the summit of the tube, 4 mm. long, whitish, lanceolate, acute. Style filiform. Stigma very small.

Trinidad, 800 feet, *M. Cardenas,* March 4, 1922 (*no. 24, special*). A specimen collected near Reyes, 1,000 feet, *O. E. White,* October 27, 1921 (*no. 1522*) exhibits slight differences in calyx, etc., but probably pertains to this species.

MACROPHARYNX gen. nov.

Calyx deeply 5-parted, the lobes narrow, attenuate, the base within indefinitely glandular. Corolla salver-form, the tube short, cylindraceous, thickened, contracted above, the throat elongated, infundibular, without scales or annulus, the lobes ample, dextrorsely obtegent, not contorted. Anthers sessile, attached at the summit of the tube, projecting into the throat, and forming a cone about the stigma, the adnate filament bearing a gland-like enlargement on the inner surface. Anther terminating in a long, acuminate, rigid appendage, the base sagittate and bearing inflexed, rigid, acute caudae. Disk annular, of 5 coherent lobes. Ovaries closely approximate but distinct. Stigma bearing, just below the middle, a ring of 5 white or greenish distinct spreading appendages, and at the summit several unequal aristae. Fruit unknown.

A stout, high-climbing vine with hollow stems. Leaves opposite, ample, the interpetiolar lines very stout. Racemes axillary, simple, densely flowered, strongly nodose, clothed, like the pedicels and base of calyx, with elongate narrow bracts, sometimes simulating a double calyx. Flowers large, white, fragrant.

Genus apparently allied to *Urechites*.

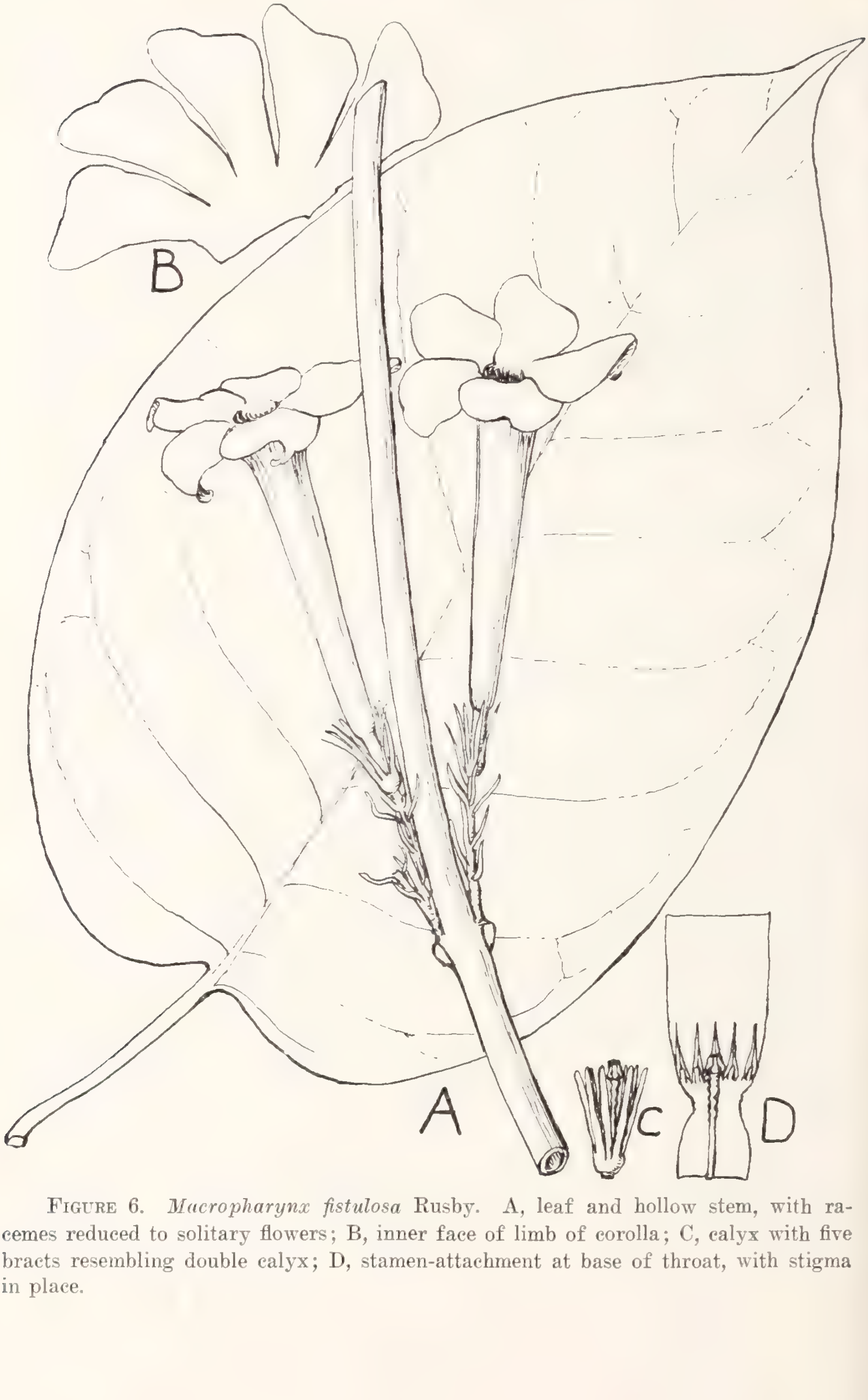


FIGURE 6. *Macropharynx fistulosa* Rusby. A, leaf and hollow stem, with racemes reduced to solitary flowers; B, inner face of limb of corolla; C, calyx with five bracts resembling double calyx; D, stamen-attachment at base of throat, with stigma in place.

Macropharynx fistulosa

Tomentellate throughout. Internodes very long, fistulous. Petioles to 4 or 5 cm. long, broad, the margins involute, ciliate. Blades to 2 dm. long and nearly as broad, ovate with shallowly cordate and often oblique base and mucronate summit, entire, thin, deep-green and sparsely tomentellate above, where the mid-rib is channeled, ferruginous-tomentellate beneath, where the broad midrib and secondaries are prominent, the secondaries opposite, about 10 pairs, widely spreading and lightly curved, the remaining venation obscure. Racemes axillary, few-flowered, the rachis roughly nodose. Pedicels slender, 1 or 2 cm. long, clothed with numerous bracts which are unequal and 1 to 2 cm. long, sinuous, narrowly linear and attenuate, and extending to and sometimes upon the base of the calyx. Calyx truncate at the base, deeply parted, the lobes similar to the bracts, but a little wider. Corolla-tube 12 mm. long, narrower than the infundibular throat, which is 2.5 cm. long the limb 3 cm. or more wide, the lobes broad and rounded. Anthers 9 mm. long, the basal lobes setaceous, 2 mm. long. Ovaries 1.5 mm. long, twice as long as the disk. Style filiform.

Rurrenabaque, 1,000 feet, *M. Cardenas,* December 1, 1921 (*no. 1894*); and at same place, *O. E. White,* January 30, 1922 (*no. 2360*). Mr. Cardenas says "Flowers white, fragrant." Mr. White says " 'Claro bejuco'. A vine to 30 or 40 feet, or more, on trees. Flowers greenish-cream, with faint red tinge on petal-lobes. Flowers have a very strong clove-like odor." The flowers of no. 2360 are smaller and somewhat differently proportioned, and may possibly represent a second species.

Prestonia cornutisepala

Tomentose throughout. Stems elongate, stout, terete. Petioles 1 or 2 cm. long, stout and broad, the margins involute, slightly peltately attached, but the base of the blade adnate. Blades to 1.5 dm. long and more than 1 dm. wide, ovate with broadly rounded base and abruptly very short-acuminate and acute summit, entire, thin, the upper surface deep-green, very shortly, densely, closely and finely tomentellate, the lower surface strongly ferruginous-tomentose, with the stout midrib and secondaries and the finer venation all prominent. Secondaries about 12 on each side, mostly subopposite, widely spreading and falcate at the ends, connected by very numerous crooked tertiaries, the finer venation strongly anastomosing. Cymes opposite the leaves, the second leaf of the pair wanting, shortly and very stoutly peduncled, compound, very densely flowered. Flowers sessile or nearly so. Bracts nearly 2 cm. long, shaped like the leaves. Calyx parted to the base, the lobes oval, about 8 mm. wide, keeled on the inner face, the extremity of the keel thickened, extended into a short indurated acute cusp and bearing a short inflexed awn, the base bearing 5 ovate pilose scales, 4 or 5 mm. long, their summits fimbriate. Corolla-tube about as long as the calyx, 6 or 7 mm. wide, the limb more than 2 cm. wide, the lobes large, rounded. Corolla bearing a strongly thickened ring at the base of the lobes. Only one ligule seen, this attached some distance below the ring. Filaments slender, about half the length of the anthers, which are 6 mm. long, short-acuminate, sagittate, the basal lobes acute, about 1 mm. long. Disk nearly twice the length of the ovaries, of 5 more or less connate, equal scales, which are obtuse, slightly notched at the summit, and furrowed down the back.

Ixiamas, 800 feet, *M. Cardenas,* December 17, 1921 (*no. 1928*). Species very near *P. latifolia* Benth.

Prestonia cephalantha

Entire plant, with the exception of the upper leaf-surfaces, densely clothed with a short yellow tomentum. Branches elongated, twining, stout, terete, with elongated internodes. Petioles 1 to 2 cm. long, very stout. Blades to 1.5 by 1 dm., ovate, acute, with rounded base, entire, thick, above very minutely papillose-hairy and pilose on the veins, which are narrowly impressed, all the venation stoutly prominent beneath, the secondaries 10 or 12 on each side, widely spreading, the ends up-curved to connect in a marginal line, and connected by numerous tertiaries, the finer venation finely and strongly anastomosing. Inflorescence capitate, densely many-flowered, the heads about 5 cm. broad, shortly and stoutly peduncled. Pedicels 5 mm. long, very thick, hirsute, like the calyx and corolla. Calyx parted almost to the base, the tube subrotate, the lobes about 12 mm. long, oval or ovate, acute or mucronate, thick. Scales 4 mm. long, erect, lance-ovate, acute, densely hirsute. Disk annular, very short. Corolla salver-form, the tube 15 mm. long, about 4 mm. broad, the lobes about 1 cm. long, suborbicular. Anthers shortly exserted, 5 mm. long, the basal lobes short, narrow, very acute. Ovaries blackish, stout, shorter than the scales.

Ixiamas, 800 feet, *M. Cardenas,* December 17, 1921 (*no. 1928*). "Flowers yellow. Growing in sandy loam, in sunshine."

Asclepiadaceae

Tassadia rhombifolia

Minutely downy, the leaf-surfaces minutely papillose, the papillae bearing extremely short hairs. Branchlets very slender. Petioles 2 or 3 mm. long. Blades (only the small upper ones seen) to 3 cm. long and more than half as wide, rhomboidally ovate or oval with acute base and very abruptly short-pointed apiculate summit, thickish and rigid, yellowish-green, the venation obscure and anastomosing to form a narrow marginal band. Midrib bearing one or two minute glands near the base on the upper surface. Flower-branchlets very short, bearing the cymes somewhat crowded, the cymes 1.5 cm. broad, about 10-or 12-flowered. Mature flower-bud 4 or 5 mm. long. enlarged at base and summit, obtuse. Calyx campanulate, lobed about half way, the lobes obtuse. Corolla-tube urceolate, about a third the length of the lobes, which are 3 mm. long. Crown about as long as the corolla-tube, a little longer than the stamens, the ligules narrow but obtuse. Beak of the stigma about half as long as the corolla-lobes, distinctly 2-cleft.

A small twig, bearing three leaves and several cymes was collected on the Mulford Expedition, without locality or date. It may bear the number *208A*. It was probably secured in the vicinity of Canamina, at 3,000 or 4,000 feet altitude.

Tassadia Hutchisoniana

Appearing glabrous, but with an extremely fine and minute puberulence. Stems slender, terete, finely striate. Petioles about 5 mm. long, broad, frequently twisted or curved, the margins involute. Blades to 1 dm. long and 4 cm. wide, oblanceolate, with acute or obtusish base and very abruptly acuminate summit, the acumination acutely mucronate; thick and rigid, deep-green but slightly gray above, pale gray-green beneath, bearing a pair of small brown glands at the base of the midrib on the upper surface, the venation obscure, the secondaries 8 or 10 on each side, forking a little beyond the middle. Panicles sparingly branched, the branches slender, the cymes not approximate, mostly less than 1 cm. broad, mostly 5- to 7-flowered. Mature flower-buds 2.5 mm. long, lanceolate, obtuse, the basal half somewhat enlarged. Calyx-lobes nearly as long as the corolla-tube, narrowly lanceolate, acute. Corolla-tube urceolate, about a third as long as the narrow lobes. Divisions of the crown setaceous, nearly as long as the anthers. Beak of the stigma equaling the corolla-lobes, the summit obscurely 2-lobed.

Huachi, 1,800 feet, *O. E. White,* August 15, 1921 (*no. 966*). "A woody vine, to 12 feet, growing in damp sandy loam in shady forest, the flowers creamy white." Species dedicated to Mr. R. H. Hutchison, the efficient secretary of the Mulford Expedition.

Funastrum fragile

Gray-tomentellate throughout. Stems very slender, terete, finely costate. Petioles to 1 cm. long, slender, mostly twisted. Blades to 5 cm. long, 2.5 cm. wide, ovate, with lightly cordate base, acute at the summit, with a very slender acute beak 3 or 4 mm. long, very thin, sparingly pubescent above, more so beneath, the midrib strong, reddish-green, the secondaries 10 or 12 on each side, divaricate, forking and connecting near the margin, the venation coarsely anastomosing. Peduncles short, densely many-flowered. Pedicels 15 mm. long. Calyx 7 or 8 mm. broad, deeply lobed, the lobes ovate, acutish. Corolla rotate, 2 cm. broad, deeply lobed, the lobes ovate, obtuse, ciliate. Outer crown adnate to the corolla-base, with a thickish sinuate margin. Inner crown of 5 thin scales, which are a half longer than the stamens, ovate, obtuse, plane. Anthers nearly 2 mm. long, the basal membranes conspicuous, the inflexed terminal appendages short and broad, auriculate at the base. Corpuscles small, rounded, the pollinia oblong, more than 1 mm. long, lightly curved.

On the River Ibon, 500 feet, *O. E. White,* February 23, 1922 (*no. 2088*). "Climbing bushes along water-side in full sunshine. Calyx greenish-cream color; corolla white."

Funastrum lanceolatum

Densely and softly white-pubescent, with spreading hairs. Stems very slender, twining, terete. Petioles 2 or 3 mm. long, broad, tomentose, like the nodes. Blades to 4 or 5 cm. long and 1.5 cm. broad, varying from lanceolate to oblong or slightly oblanceolate, with rounded base and acutely mucronate summit, thin, lightly puberulent above, where the principal veins are lightly prominent, tomentellate beneath, the secondaries 12 or 14 on each side, almost divaricate, connecting at the margin. Peduncles unequal, mostly elongate, slender, loosely several- to many-flowered. Pedicels slender, 2 or 3 cm. long. Calyx 8 mm.

broad, deeply 5-parted, the lobes ovate, acute, slightly concave. Corolla puberulent, rotate, 1.5 cm. broad, the lobes ovate. Outer crown adnate to the corolla, short, with a very narrow membranaceous free margin. Inner crown of 5 scales which are a little longer than the anthers, obovate, obtuse, plane, membranaceous. Anthers 2 mm. long, the basal membranaceous appendages conspicuous, the inflexed apical membranes large, very broad. Stigmatic beak nearly 2 mm. long, conic, dark-brown, obscurely 2-lobed. Corpuscles of the pollinia large. Pollinia oblong, more than 1 mm. long, lightly curved.

Trinidad, 700 feet, *M. Cardenas,* March 6, 1922 (*no. 2, special*). Species peculiar among its Bolivian relatives in having non-cordate leaves.

Vincetoxicum cuspidatum

(Fruiting specimen.) Stems twining, stout, sulcate, setose, or tomentose in places. Only the small uppermost leaves seen. Petiole 5 mm. long, stout, reddish, like the principal veins. Blade 5 cm. long, 3 cm. wide, obovate with slightly cordate base and rounded or retuse summit, the midrib extended into a short stout cusp; deep-green, both surfaces tomentose, the venation not prominent, the secondaries about 5 or 6 on each side. Peduncle of the mature follicle to 4 or 5 cm. long, stout, strongly setose-hispid. Follicle 8 cm. long, 3 cm. broad, ovoid, the pericarp thick and coriaceous or ligneous, brown. Prickles stout, straight or slightly curved, pungent, about 3 mm. long, laterally flattened. Seeds dark-brown or blackish, 5 to 7 mm. long and nearly or quite as broad, obovate, the summit truncate and usually lightly dentate, a longitudinal ridge upon the side.

Without data as to locality or season. Species very near *V. ellipticum* Rusby.

Roulinia Mannii

Younger portions and inflorescence gray-pubescent. Stems slender, twining. Petioles to 3 cm. long, slender, the margins involute. Blades to 7 cm. long and 4 cm. wide, ovate, with cordate base, the sinus deep and narrow, the basal lobes rounded, and with abruptly short-acuminate and acute summit, very thin, very minutely papillose on both surfaces, with very short appressed hairs, the slender venation conspicuous, the secondaries 7 or 8 on each side, the fine venation scanty. Peduncles longer than their petioles, the flowers racemose at the upper part, the pedicels unequal, the longest nearly 1 cm. long, slender. Calyx rotate, deeply 5-parted, the lobes 3 mm. long, narrowly ovate, acute, membranaceous. Corolla rotate, deeply 5-parted, the lobes 5 mm. long, 3 mm. wide, lanceolate, acute. Ligules of the crown half as long as the corolla-lobes, thin and membranaceous, their breadth at the summit about equaling their length, narrowed to the base, lightly 4-crenate and bearing from a notch in the center an abruptly inflexed terminal ligule. Stamens shorter than the crown, bearing short broad inflexed white terminal appendages. Corpuscle small, rounded, the pollinia oval, short and broad. Follicle 8 cm. long, slender, long-acuminate, glabrous.

Trinidad, 700 feet, *M. Cardenas,* March 8, 1921 (*no. 9, special*). Species dedicated to Dr. Wm. M. Mann, the learned and industrious entomologist of the Expedition.

Gothofreda macroglossa

Softly pubescent with spreading white hairs. Stems to 5 dm. or more high, erect or ascending, slender, simple, terete. Petioles 4 mm. long, slender. Blades to 4 cm. long and 1.5 cm. broad, lanceolate with slightly cordate base and mucronate acute summit, entire, softly gray-tomentellate on both surfaces, the stout red midrib prominent beneath, the secondaries 6 or 8 on each side, crooked. Umbels terminal and axillary, solitary, simple, rather dense, on peduncles much less than half the length of their leaves. Pedicels 2 or 3 mm. long, subtended by setaceous bracts. Calyx 5-parted almost to the base, the lobes regularly attenuate from the narrow base. Corolla-tube very short, crateriform, the lobes 6 mm. long, ligulate, acuminate from the base, obtusish, recurved and twisted. Corona of 5 distinct ligules, slightly adnate to the base of the stamen-tube, 3 or 4 mm. long, linear and slightly wider near the summit, erect, not appendaged. Anther appendages white, about 1 mm. long, oval, obtuse. Styles 8 mm. long, united two thirds of their length, filiform. Follicle 6 or 7 cm. long, narrowly lanceolate, slightly curved, tomentellate.

Reyes, 1,000 feet, *H. H. Rusby,* September 26, 1921 (*no. 1324*).

Gothofreda consimilis

Densely pilose, with divaricate white hairs. Stems to 5 dm. high, erect or ascending, simple, slender, terete. Leaves subsessile, to 4 cm. long and nearly 2 cm. wide, lance-oblong with lightly cordate base and acute or slightly mucronate summit, entire, densely and softly pubescent on both surfaces, the venation rather stout but inconspicuous. Umbels solitary in the axils, mostly simple, rather dense on erect peduncles shorter than their leaves, mostly fifteen or fewer-flowered, the pedicels 3 or 4 mm. long, subtended by small setaceous bractlets. Corolla-tube nearly hemispheric, 2.5 mm. long, the lobes 5 mm. long, lanceolate, obtuse, recurved and twisted. Corona of 5 erect distinct lanceolate obtuse pilose entire ligules, 3 to 4 mm. long, unappendaged and adnate to the lower half of the stamen-tube. Anther-appendages erect, connate midway, thickened and hardened. Styles 5 mm. long, united half way, pilose, the branches slightly flattened.

Reyes, 1,000 feet, *H. H. Rusby,* September, 1921 (*no. 1995*-A). Very near *G. macroglossa,* from which it differs in the higher adnation of the corona, the longer corolla-tube, the very distinctive indurated anther-appendages and the shorter and less united stouter styles. Both species, together with *G. Martii,* grow in open grassy places, the plants scattered singly amidst the grass. *G. macroglossa* is rather more inclined to grow in partially shaded places.

Gothofreda Pearsoni

Softly white-pubescent. Stems elongate, twining, terete, rather stout. Petioles to 4 cm. long, flattened on the upper surface, reddish, like the principal veins of the lower surface. Blades to 9 cm. long, and half as broad, ovate, cordate with a deep and narrow sinus and rounded lobes, abruptly acuminate with attenuate apex, thin, softly pubescent, especially beneath, with 4 pairs of basal nerves in addition to the midrib sharply prominent beneath. Cymes sessile in the axil, mostly about 5-flowered, the pedicels about 4 mm. long, slender. Calyx-lobes 3.5 mm. long, subulate, attenuate, green. Corolla more than twice the length of the calyx, the lobes acuminate, tomentose. Ligules of the crown about 1 mm. long, erect, ovate, obtuse. Appendages of the stamens longer than the anthers, subulate, acuminate, erect. Corpuscles nearly 1 mm. long, the pollinia shorter, narrow. Beak of the stigma parted two thirds of the way, the branches extending nearly the length of the corolla, stout, puberulent.

Rurrenabaque, 1,000 feet, *M. Cardenas,* January 9, 1922 (*no. 2035*). Species dedicated to Dr. Pearson, the talented ichthyologist of the Expedition.

Nephradenia pendula

Lower portion of stem very minutely scabrellate, and the peduncles very minutely puberulent. Stems 4 to 6 dm. high, erect, simple, slender, green, finely costate, the internodes a little longer or a little shorter than their leaves. Leaves opposite, 2 to 4 cm. long, appearing 1 to 2 mm. wide in their revolute state, sessile, linear or lance-linear, erect, rigid, very acute and nearly pungent, thickish, entire, the margins strongly revolute, strongly keeled, the numerous secondaries elevated so as to give a nodose feeling to the touch. Peduncles in one, occasionally in both axils, recurved, filiform, 2-flowered, 7 or 8 mm. long, a little longer than the pedicels, which are slightly unequal, pendulous, minutely bracted at the base, sharply angled or narrowly winged, thickened at the summit. Calyx rotate, 5 mm. broad, membranaceous, greenish, deeply 5-lobed, the lobes equal, ovate, obtusish. Corolla white, broadly campanulate or nearly hemispherical, deeply 5-lobed, the lobes oval, obtuse, 7 mm. long. Crown of 5 scales, which are erect and adnate by their face to the entire length of the stamen-tube, thin, rigid, the lower portion bearing a broad, thick keel from the center. Pollinia above the level of the stigma, horizontal, borne on very short pedicels close to the short erect corpuscle.

Ixiamas, 1,000 to 1,500 feet, *M. Cardenas,* December 15, 1921 (*no. 1907*). "In sunny places, in clay-soil, on pampa. Plant 2 to 3 feet high, with white flowers."

CONVOLVULACEAE

Jacquemontia bifurcata

Tomentellate throughout. Stems slender, tough, terete, twining. Petioles to 8 mm. long, rather stout. Blades to 4 cm. long and half as wide, oblong, with rounded base and blunt, apiculate summit, entire, thick, drying brownish, softly tomentellate on both surfaces, the secondaries about 7 or 8 on each side, ascending, nearly straight, strong and prominent beneath, like the midrib. Peduncles longer than the leaves, densely many-flowered at the summit, mostly bifurcated. Calyx 4 mm. long, the sepals subequal, the three outer a little wider, ovate, acute or obtusish, thickish. Corolla about twice as long as the calyx, nearly 1 cm. broad, bright-blue. Dissection material wanting.

Espia, 3,500 feet, *H. H. Rusby,* July 20, 1921 (*no. 113*).

Jacquemontia agricola

Densely pubescent with short, coarse, divaricate hairs and apparently clammy. Stems elongate, slender twining. Petioles to 1 cm. long, slender. Blades to 3 cm. long and half as wide, ovate, with rounded or subcordate base and acuminate and acute summit, thickish, pubescent, especially beneath, the secondaries, about 6 on each side, impressed above, thick and prominent beneath. Peduncles elongate, rigid, the numerous flowers crowded at the summit and linear-bracted. Sepals 6 to 8 mm. long, the three outer much larger, lanceolate and long-attenuate. Corolla lilac, campanulate, about 1 cm. long, shortly 5-lobed, the lobes mucronate. Stamens about half the length of the corolla, inserted at its base, the filaments filiform, the anthers oval, obtuse. Style exceeding the stamens, the stigmas two, broadly ovate, compressed. Mature capsule shorter than the sepals.

A weed in cultivated ground, at Canamina, 4,000 feet, *H. H. Rusby,* July 15, 1921 (*no. 80*).

HYDROPHYLLACEAE

Nama longifolia

Calyx sparsely white-pilose, the younger stems and upper surface of the young leaves very minutely scabrate. Stems a meter or more high, erect, branched above, pale-green, nearly glabrous, the branches mostly short, ascending. Leaves sessile, to 1 dm. long and 1.5 cm. wide, oblanceolate, with long-acuminate base and acute or obtusish summit, entire, thin, pale-green, the midrib prominent on both sides, more so beneath, the remaining venation very slender, the secondaries strongly ascending. Flowers densely racemose at the ends of the branches. Pedicels slender, shorter than the flowers. Bracts lanceolate, acuminate, unequal, some longer than the calyx. Sepals 4 mm. long, 1.5 or 2 mm. wide, ovate, acute, with a strong midrib, sparsely clothed with long bristly hairs, slightly united at the base. Corolla longer than the sepals, parted almost to the base. Stamens attached to the base of the corolla and about equaling the corolla, the lower half of the filaments abruptly and broadly dilated. Ovary subglobose, 1 mm. broad, glabrous, bearing a small blackish tubercle from which the styles arise. Styles curved, flattened, broader above, the stigma blackish. Capsule globose, 5 mm. broad, light-brown, shining, bearing the persistent styles.

Ixiamas, 800 feet, *O. E. White,* December 16, 1921, (*no. 1146*). "Growing in the edges of ponds, in sunshine, the flowers light-blue. Very rare." The species is related to *N. caroliniana.*

VERBENACEAE

Lippia venosa

Densely and very shortly gray-tomentellate throughout, the long slender branches somewhat quadrangular and sulcate. Petioles 4 to 8 mm. long, the blades 3 to 5 cm. long, 1 to 2 cm. broad, ovate with abruptly acuminate base and long-acuminate and acute summit, shortly crenate-dentate, thickish, light-green above, gray beneath, rather strongly bullate above by the impressed venation, which is very prominent and stout beneath, the strongly ascending secondaries about 5 on a side, connected by a strong reticulation. Heads solitary in the axils, the slender peduncles half as long as their leaves, or longer, mostly nearly 1 cm. broad. Bracts ciliate, broadly ovate, acute. Calyx broadly campanulate, 2-fid, the divisions broader than long. Corolla-tube minutely puberulent, incurved, 5 mm. long, contracted just above the base, then gradually dilated to three times that width, and lightly contracted at the summit, the limb 5 mm. broad, the upper lip very slightly retuse, the lower with 3 rounded lobes which are rather broader than long. Shorter anthers reaching to about the middle of the tube.

Espia, at the head of the Bopi River, about 3,500 feet, *H. H. Rusby,* July 20, 1921 (*no. 99*); Canamina, 4,000 feet, *O. E. White,* July 21, 1921 (*no. 268*).

Petrea fragrantissima

Scabrous throughout, the branches stout, terete, light-gray. Petioles 1 to 1.5 cm. long, stout, the margins strongly involute. Blades 12 to 18 cm. long, 7 to 12 cm. broad, with rounded base and obtuse or acutish summit, entire, thickish, and rigid, deep-green, the venation lightly prominent above, sharply and strongly so beneath, the secondaries 12 to 15 on each side, crooked, strongly anastomosing at some distance from the margin, and connected by a very loose angular anastomosis of the tertiaries. Panicles pedunculate, loosely branched, elongated, like their branches, loosely or densely flowered, recurved or pendulous, the flowers of a deep-blue color and very fragrant. Bracts equaling or exceeding the flowers, lance-linear, acuminate and acute. Flowering pedicels 1.5 mm. long, in fruit 5 to 8 mm., very slender. Tube of flowering calyx 5 mm. long, the narrow crispate lobes a little longer in fruit, the tube little longer, but the lobes 2 cm. long by 1 cm. broad, obovate with rounded summit, thin and veiny. Ligules of the calyx thick, broader than long, ovate, acutish. Filaments stout, the anthers sagittate, minutely mucronate. Style very stout.

Near Rurrenabaque, 1,000 feet altitude, *H. H. Rusby,* October, 1921 (*no. 860-A*). A stout, high-climbing vine in the forest, where *P. bracteosa* also grows, but the latter is not fragrant. This plant would be a valuable acquisition for greenhouse culture.

Callicarpa minutiflora

Gray-scurfy throughout, except the upper leaf-surfaces, which are deep-green with gray-scurfy midrib and very small scattered stellate patches. Stem tall and slender, obscurely angled. Petioles 1.5 to 2.5 cm. long, stout, the blades 1 to 2 dm. long, 5 to 10 cm. broad, lance-ovate, with somewhat cuneate base and long-acuminate and attenuate summit, very lightly sinuate-dentate, very thin, the slender venation slightly prominent beneath, the strongly falcate-ascending secondaries about 6 to 8 on a side, connecting close to the margin and connected by rather numerous very slender tertiaries. Cymes shortly and stoutly peduncled, loosely branched, the branchlets densely flowered. Calyx turbinate-campanulate, 1.5 mm. long and broad, the margin lightly sinuate. Corolla twice the length and breadth of the calyx, campanulate, lobed half way. Exserted portion of stamens twice the length of the corolla. Style about equaling the stamens, and stouter.

Rurrenabaque, 1,000 feet, November 24, 1921 (*no. 1768*). Species near *C. acuminata,* H. B. K., and may possibly prove to be only a variety of it.

PSEUDAEGIPHILA gen. nov.

Calyx campanulate, the limb normally 4-toothed, the teeth equal and erect, often irregularly 3-toothed, in fruit enlarged and coriaceous, the summit involute. Corolla marcescent, the tube straight, cylindrical, with the summit somewhat enlarged, the limb slightly bilabiate, the upper lip entire or subentire, the lower three-lobed, the lobes smaller than the upper lip. Occasionally, the corolla is 3-lobed. Stamens 4, exserted, the two long ones normally equal, the two short ones frequently unequal, the filaments attached below the throat of the corolla, somewhat flattened, the anthers attached at the back near the base, 2-celled, lightly cordate, oval, the cells parallel. With the occasional 3-lobed corolla, but 3 stamens are present. Ovary

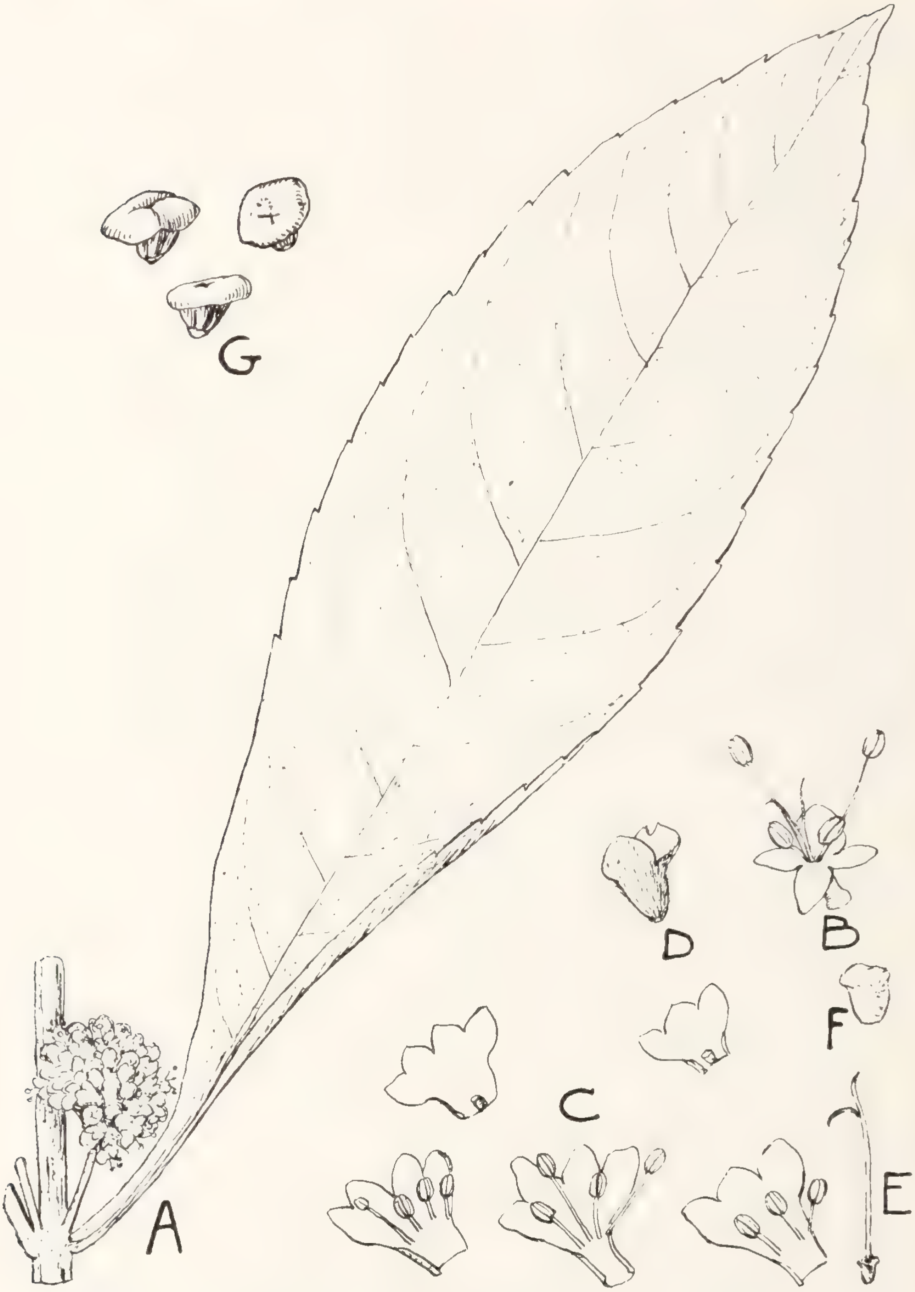


FIGURE 7. *Pseudaegiphila breviflora* Rusby. A, leaf and inflorescence; B, normal corolla and androecium, × 3; C, five figures, showing variation in corolla and androecium, × 3; D, irregularly fissured calyx, × 3; E, pistil, showing recurved appendage to ovary, × 3; F, ovary enlarged, × 6; G, three figures, showing nearly mature fruit, × 6.

hemispheric-turbinate, the truncate summit bearing a marginal recurved membranous annulus. Style exserted, filiform, bifid, the branches elongate, filiform, strongly and widely recurved. Fruit (only partially mature) closely enclosed in the base of the calyx, which is slightly contracted above it, hemispheric-turbinate, the annulus much expanded and recurved so as to conceal the upper part of the fruit, and coriaceous, shining, with concave center. Fruit 2-sulcate and 2-seeded, occasionally 3-sulcate.

A tall perennial tomentellate herb, of the habit of *Aegiphila,* with opposite leaves and small, peduncled, densely flowered compound cymes in the axils.

Pseudaegiphila breviflora

Tomentellate throughout, the indumentum extremely short and dense, brownish, except for the deep-green upper leaf-surfaces. Stems tall and stout, quadrangular and sulcate. Leaves 1 to 2 dm. long, 3 to 6 cm. broad, oblanceolate, acute, gradually tapering into a margined petiole, obsoletely sinuate-serrate, the teeth minutely pointed; thin, the scanty venation very slender, scarcely prominent on either side, the secondaries 8 or 10 on each side, lightly falcate, connected by a very few very fine tertiaries. Cymes solitary in the axils, on peduncles 1 to 2 cm. long, compound, 1.5 to 3 cm. broad, very dense. Calyx nearly 5 mm. long, the obovoid tube about 2 mm. long, the lobes short and broad, obtuse. Corolla little exceeding the calyx, the slender tube half as long as the broadly oval obtuse lobes, the stamens attached below the base of the lobes, equaling or exceeding them in length. Style filiform, the recurved filiform branches about half its length. Upper third of fruit covered by the recurved coriaceous, lustrous light-brown appendage.

Santa Ana de Yacuma, 700 feet, *M. Cardenas*, March 4, 1922 (*no. 16, special*). This peculiar plant exhibits several characters of great interest. No similar carpellary appendage is known to the writer, and its morphological relations are difficult to understand. The irregularity in the lobing of the corolla and the great diversity in stamen-characters suggests abnormal development of some kind, possibly hybridity, a suggestion that is strengthened by the obvious resemblance to both *Aegiphila* and *Callicarpa.*

Vitex pseudolea

Petioles and midribs minutely downy. Petiole very slender, somewhat shorter than the middle leaflet. Leaflets 5, the slender petiolules 6 to 12 mm. long, the blades 5 to 10 cm. long by 1.5 to 4 cm. broad, the outer successively smaller, oblanceolate, the base regularly acuminate, the summit abruptly short-pointed, acute or obtuse; membranaceous, thin, entire, the midrib and secondaries, about 15 on each side, slender and sharp beneath, the venation strongly reticulate. Cymes lateral, numerous, short-peduncled, few-flowered, the slender pedicels very unequal. Flowers bright-blue, not collected. Calyx of the young fruit crateriform to subhemispherical, lightly 5-nerved and reticulate-veiny, loosely subtending the fruit, the margin shallowly 5-crenate, each lobe bearing a minute mucro. Fruit ovoid or slightly obovoid when young, ellipsoidal when mature, purple-black, oily and sweetish, and of peculiar flavor, and as large as a small olive.

This becomes a good-sized, densely leafy tree, called *Aceituno del monte* (wild olive) and *Anacahuita*. The fruit is greedily eaten by children, and the bark is used in the treatment of rheumatism. Collected in fruit at Rurrenabaque, Bolivia, November 1921. A tree of the same name and supposedly the same was seen in flower at Santa Ana on the Bopi River, three months earlier. It was densely covered with flowers, before the appearance of the leaves (*no 767*). Also collected by Williams at Ixiamas, Bolivia. Species near *V. gigantea* H. B. K., which is a ferruginous-tomentellate species.

LAMIACEAE

Hyptis canaminensis

Scabrous, the inflorescence gray-pubescent. Stems erect, tall, slender, apparently simple or little-branched, obtusely quadrangular, the sides sulcate, often red-purple. Petioles 2 to 3 cm. long, slender, subterete. Blades to 8 cm. long and 3 cm. broad, lance-ovate with more or less cuneate base, acuminate and acute, coarsely and sharply serrate, thin, pale-green, shortly gray-hairy and somewhat rough beneath, finely scabrous above, the secondaries 5 to 8 on each side, strongly ascending and nearly straight, slender, prominent beneath. Heads slenderly racemose, the racemes axillary and in a terminal panicle, longer or shorter than their leaves, slenderly peduncled, the lower portion of the rachis leafy-bracted, the racemes interrupted. Heads at length shortly peduncled, 0.5 to 1 cm. broad, according to development, about 5-flowered, the flowers sessile. Calyx about 5 or 6 mm. long, 2 mm. broad, slightly narrowed upward, lightly curved and slightly ventricose, the teeth erect, green, subulate, acute, about 1 mm. long. Corolla somewhat exserted, the tube white, much enlarged at the base, four lobes subequal, oval, obtuse, ciliate, the anterior about as long and somewhat narrower, somewhat narrowed toward the base. Mature nutlets not seen.

Canamina, 4,000 feet, July 15, 1921, (*no. 61* and *62*). "A weed about 3 or 4 feet high, in cultivated ground." Species very near *H. yungasensis* Britton.

Hyptis compacta

Upper leaf-surfaces densely and finely short-strigose, the lower surfaces tomentose and strongly ferruginous. Stems and numerous short branches stout, obscurely angled, deep-purple, coarsely short-pilose, leafy. Petioles to 1 cm. long, stout, broad, dilated at the base. Blades to 6 cm. long and 4 cm. broad, oval, with the base abruptly contracted into the petiole and with obtuse or rounded summit, finely crenate-dentate, very thick, the venation impressed above, the strongly ascending and falcate secondaries 8 or 10 on each side, connected by numerous tertiaries. Heads sessile, crowded at the ends of the branchlets, to 1.5 cm. broad, densely very many-flowered, dark-brown, all in the mature fruiting stage in my specimens, subtended by broadly ovate acute brown bracts which equal or slightly exceed the flowers. Calyx 5 mm. long, 3 mm. broad, the tube campanulate, 10-nerved, the teeth 2 mm. long, triangular-subulate, acute, straight and erect. Nutlets small, ovoid, granular.

On the pampas about Lake Rogagua, 1,000 feet, *H. H. Rusby*, November 4, 1921 (*no.1630*). The same also collected by Steinbach in the upper valley of the Mamore.

SOLANACEAE

Bassovia minutiflora

Glabrous. Stems apparently herbaceous, terete, flexuous, much branched, the branchlets divaricate or widely spreading, very slender. Petioles to 5 mm. long, slender, continuous with the base. Blades very unequal, from 2 to 8 or more cm. long and 1 to 3 cm. broad, lanceolate, with cuneate base passing gradually into the petiole, obscurely sinuate, very thin, bright-green, the venation very slender, not prominent, the secondaries about 6 or 7 on each side, strongly ascending, lightly curved, the finer venation obscure. Pedicels pseudo-axillary, solitary, 1-flowered, filiform, nearly 1 cm. long when fully developed. Calyx-tube 1.5 mm. broad, widely campanulate, somewhat 5-angled, the lobes about 1 mm. long, ovate, thickish. Corolla more than 1 cm. broad, deeply 5-parted, the divisions ovate. Stamens nearly equal, 4 mm. long, the filaments a little longer than the anthers, filiform, dilated and slightly connate at the base, the anthers oblong, fully dehiscent longitudinally. Style blackish, about as long as the stamens, sigmoid-curved, the stigma small.

Huachi, 3,000 feet, *H. H. Rusby,* August 21, 1921 (*no. 680*).

Solanum setosicalyx

Branches, petioles, etc., sparsely armed with short, straight divaricate pungent yellow prickles, their bases stout and laterally flattened, their upper portions slender; scabrous with short rigid, pungent white hairs borne on stout papillae. Branchlets woody, very stout, terete, flexuous. Petioles about a fourth of the length of the blades. Leaves to 15 cm. long, and about two thirds as broad, irregularly oval, with very unequal subtruncate base and broad summit, very coarsely sinuately dentate, the teeth 2 or 3 on each side, directed outward, broadly triangular, mostly obtuse, the sinuses of similar form or broader; upper surface deep-green, sharply strigose, the hairs distinct but numerous; hairs of the lower paler surface much shorter but on much larger papillae. Secondaries about 8 to 10 on each side, widely spreading, nearly straight, slightly impressed on the upper surface. Pseudo-racemes lateral, shortly peduncled, more or less recurved, densely clothed, including the calyx, with long straightish coarse pungent hairs. Pedicels, in flower, 1.5 to 2 cm. long, slender. Mature bud 2 cm. long, 1 cm. broad, ovoid, blunt, the calyx nearly half the length, divided nearly to the base, the lobes lance-ovate, attenuate. Corolla apparently pale-violet, tomentellate externally, rotate, when expanded 4 cm. broad, the lobes stoutly ribbed. Stamens 1.5 cm. long, one a little longer than the others, the anthers regularly lance-linear, obtuse or subtruncate, the pores small, looking inward, upward and laterally. Fruit unknown.

A shrub in a coffee plantation at Huachi, 3,000 feet, *H. H. Rusby,* August 30, 1921 (*no. 451*).

Solanum poinsettiaefolium

Apparently unarmed; densely short-tomentose throughout, with gray stellate hairs. Branches woody, ascending, rather stout, flexuous, terete, gray. Petioles about a fourth of the length of the blades, slender, terete, divaricate or recurved. Blades to 8 by 5 cm., ovate, acute, with oblique obtuse or acutish base, coarsely dentate, with 2 or 3 large teeth on each side, the teeth broadly triangular, blunt and pointing outward, the broad sinuses obtuse or rounded, about as large as the teeth; thickish, grayish-green above, gray and densely tomentose beneath, the venation coarse, prominent, though little elevated beneath, the secondaries about 7 to 9 on each side, diverging at about 45 degrees, little curved but rather crooked, coarsely branching. Pseudo-racemes lateral, the peduncle nodose, as with scars of fallen flowers. Pedicels, in flower, 1 to 1.5 cm. long, slender. Mature bud 2 cm. long, 5 mm. broad at the base, lanceolate, blunt, the summit usually a little oblique, the calyx about a fourth of the length, divided almost to the base, tomentose externally, nearly glabrous within, thin, the tube shortly and broadly campanulate, the lobes ovate, subtruncate and bearing a stout awn about half as long as the body. Corolla tomentose, divided nearly to the base, apparently white, the lobes ovate. Stamens equal, 5 mm. shorter than the corolla, the filaments very short, the anthers lance-linear, tapering regularly from base to summit, the summit lightly curved, truncate, the pores rather large, looking inward and a little upward. Style stout, 2 or 3 mm. longer than the stamens, the summit lightly curved. Fruit unknown.

In copses on the pampas near Lake Rogagua, 1,000 feet, *M. Cardenas,* November 7, 1921 (*no. 1695*).

Solanum arachnidanthum

Armed with very short stout strongly laterally flattened recurved yellow shining pungent prickles. Densely, shortly and harshly tomentellate, with stellate hairs, and of a yellowish gray-green. Branchlets short, stout, flexuous, terete. Leaves to 8 by 2 cm., tapering into a petiole-like base, acutish, or sometimes acuminate, sometimes entire, but usually sinuous, with one to three coarse teeth on each side, thickish, scabrous on both surfaces, the hairs appressed, slender but rigid, the secondaries about 4 on each side, coarse and crooked. Racemes lateral, sessile or short-petioled, few-flowered. Pedicels 5 to 8 mm. long, rather stout. Calyx-tube broadly campanulate, about 2 mm. long by 4 mm. broad, the teeth subulate, about as long as the tube. Corolla, just before opening, 5 cm. long, the summit obtuse, strongly recurved, in flower parted almost to the base, the segments linear, tomentose externally. Stamens subequal, as long as the corolla, the filaments 2 mm. long, the anthers slender, long-acuminate, the summit recurved, the elongate whitish pores looking inward. Style considerably longer than the stamens, very slender, recurved. Young fruit globose, shining.

Trinidad, 700 feet, *M. Cardenas* (*no. 3, special*). "A shrub 2 feet high, in sandy loam, the flowers white, the fruits black, 5 mm. wide."

Solanum steironematophyllum

Prickles occasional on branches, petioles and midrib. Young leaves, etc., bearing scattered minute stellate hairs, otherwise glabrous. Branches elongated, slender, flexuous, nearly terete, pale-green. Prickles yellow, shining, very small, pungent, nearly straight, terete, or very slightly laterally compressed. Petioles about one fourth as long as the blades, slender, ascending, narrowly channeled above. Blades to 14 by 5 cm., regularly lanceolate with acuminate base and long-acuminate and acute summit, obscurely sinuate, very thin, deep-green, the midrib and secondaries prominent beneath, the secondaries about 10 on each side, slender, strongly ascending, the terminal portions upturned, connected by few crooked tertiaries. Raceme lateral, sessile or shortly peduncled, about 5- to 10-flowered, the peduncle and rachis more or less angled. Pedicels very slender, about 1.5 cm. long, divaricate, becoming reflexed in fruit. Flowering calyx 5 mm. long, the hemispheric tube very short, the lobes narrowly lanceolate. Corolla, just before opening, about 9 mm. long, apparently becoming nearly rotate, deeply parted. Stamens 8 mm. long, slightly unequal, the filaments very short, the anthers lanceolate, the beak about one third of the length, slightly curved, the pores small, terminal, looking upward and a little inward. Calyx slightly enlarging in fruit, the berry nearly globose, about 8 to 10 mm. broad.

(*No. 827.*) Species very near *S. coerulescens* Sendt.

Solanum rogaguense

Sparsely armed with very short stout straight yellowish prickles, which are somewhat flattened laterally. Younger portions and inflorescence very shortly and minutely stellate-puberulent. Branchlets elongate, slender, erect or strongly ascending, green, striate, or angled when young. Petioles to 3 cm. long, slender, sparsely prickly, like the midrib underneath and occasionally above, with slender prickles, at first erect, at length divaricate. Blades to 1 dm. long and 4 cm. broad (the lower probably larger), lanceolate to oblanceolate, acuminate at both ends, acute, sparingly sinuate-dentate, the teeth small, triangular, directed outward, very thin, deep- but dark-green, nearly glabrous above, sparsely and very shortly stellate-hairy beneath, where the slender venation is lightly prominent, the secondaries about 8 or 10 on each side, strongly ascending except at the erect ends. Inflorescence terminal, pseudo-racemose or paniculate, small, few- to many-flowered, the rachis nodose from the fallen flowers. Pedicels to 2 cm. long, nearly filiform, upwardly thickened. Calyx-tube nearly hemispherical, 1.5 mm. broad, the lobes 4 mm. long, subulate, acute. Corolla nearly 1 cm. long, puberulent, apparently white, divided nearly to the base. Filaments very short. Anthers regularly acuminate from the base, the longest 7 mm., the shortest 5 mm. long, the pores looking upward and a little inward.

Near Lake Rogagua, 1,000 feet, *H. H. Rusby* (probably as a part of *no. 827*).

Solanum canaminense

Armed with scattered very small yellow shining strongly recurved prickles which are pungent and slightly flattened laterally, densely soft-tomentose with gray or yellowish hairs. Branches elongated and stout, somewhat flexuous, terete. Petioles 2 to 5 cm. long, recurved-spreading, stout, bearing a few prickles, as does the midrib underneath. Blades 12 to 20 cm. long by 4.5 to 8 cm. broad, oval-ovate, with obtuse or acute base slightly produced into the petiole and obtuse or acutish summit, entire, thickish, deep-green above, with straight white hairs amidst the matted darker ones, paler beneath, with the slender venation conspicuous, crooked and coarsely anastomosing, the secondaries 7 to 10 on each side, strongly falcate-ascending. Cyme terminal, small, dense, branching. Pedicels 5 to 8 mm. long, very stout. Mature bud 12 to 15 mm. long, 5 mm. wide, the calyx two third of the length, the corolla obtuse, angled. Calyx-tube crateriform, 5 mm. wide, the lobes linear-attenuate. Expanded corolla deep-purple, nearly 3 cm. wide, subrotate, densely long-pilose, deeply lobed. Stamens equal, two thirds as long as the corolla, the anthers regularly lanceolate, straight, the pores elongate, looking inward, and a little upward. Style exceeding the stamens, the summit incurved. Fruit not seen.

Canamina, 4,000 feet, *O. E. White,* July 28, 1921 (*no. 408*). "A spreading tree, 10 to 18 feet high, growing in damp shady ravines, associated with *Bocconia.*"

Solanum sassafrideum

Apparently unarmed; densely and shortly ferruginous-tomentose, the tomentum interspersed with longer straight or curved coarse whitish stiff hairs, which also occur on the midrib of the upper leaf-surface, which is strongly and harshly muricate. Branches and branchlets short, very stout, terete. Only the upper leaves seen, there probably being others, much larger. Petioles 4 or 5 cm. long, 4 or 5 mm. thick. Blades broken in my specimen, and their characters imperfectly displayed. They are about 1.5 dm. long and nearly as wide, obovate, with cordate base, its sinus narrow, the summit not seen; margin unequally and irregularly lobed, the lobes blunt or obtuse, sometimes narrowed toward the base; leaf thick, above deep-green and somewhat ferruginous, harshly papillose, beneath grayish-ferruginous and densely short-tomentose, the principal veins coarse and prominent. Principal secondaries 7 or more, at an angle of about 45 degrees, nearly straight, with numerous smaller intermediate ones, which are divaricate. Cyme terminal, dichotomous, broad, densely flowered at the ends of the branchlets, which are deeply ferruginous-tomentose, marked with whitish depressions from the fallen pedicels, which are very short and stout. Mature bud 1 cm. long and half as broad, nearly ellipsoid. Calyx-tube between crateriform and hemispheric, 4 mm. wide, 5-ribbed, the teeth triangular-subulate, longer than the tube, acute, keeled. Corolla tomentose, on both surfaces, whitish, rotate, nearly 2 cm. broad, lobed two thirds of the way, with plicate folds in the sinuses, the lobes ovate, obtuse, 3-nerved, the margins involute. Filaments extremely short, the anthers deep-purple, slightly unequal, about 6 mm. long, oblong or a little narrower above, obtuse, the pores whitish, looking inward and laterally.

Pongo de Quime, 11,500 feet, *O. E. White,* July 12, 1921, (*no. 156*). "A small tree, 12 to 15 feet high, with white flowers, growing in full sunshine."

Solanum pongoense

Unarmed, the young leaves very minutely puberulent. Much branched, the branchlets short, stout, somewhat angled when young. Leaves very unequal, the petioles of the larger ones to

1 cm. long, slender, channeled above. Blades to 3.5 by 1.5 cm., lanceolate, mostly with acute base and obtuse summit, entire, thickish, the midrib and secondaries sharply prominent beneath, the secondaries about 6 on each side, strongly ascending and little curved. Cymes terminating the branchlets, mostly few-flowered, dichotomous. Pedicels 5 to 7 mm. long, filiform, recurved, thickened upward and continuous with the calyx-tube. Flower about 7 mm. long, the calyx nearly a third of the length. Calyx campanulate-turbinate, the lobes about 1 mm. long and broad, obtuse. Corolla bluish-white, pubescent, lobed nearly half-way, the lobes ovate, obtuse. Stamens nearly equaling the corolla, the filaments stout, flattened, two thirds the length of the anther, which is oblong, straight, cordate at the base, truncate, brown, completely dehiscent from the base to the pores, which are rather large, looking inward and upward. Style slightly exceeding the stamens, slender, nearly straight. Fruit depressed-globose, 4 or 5 mm. broad.

Pongo de Quime, 11,000 feet, *O. E. White,* July 5, 1921 (*no. 165*). "A shrub 5 to 10 feet high, common in gulches, near river."

This very strange species well illustrates the aberrant tendencies of the genera of this group. The habit of this shrub is much like that of a *Poecilochroma,* with which it grows, as well as with *Solanum* and *Lycianthes.* Its filament is that of *Bassovia,* but its anther has distinct pores, as well as sutures. Its openly cordate anther-base distinguishes it from any species of any of these genera known to me. On the whole, I think it cannot be separated from *Solanum.*

Lycianthes subfalcata comb. nov.

Brachistus subfalcatus Rusby, Bull. N. Y. Bot. Gard. **8**: 117.

Rurrenabaque, 1,000 feet, *M. Cardenas,* November 25, 1921 (*no. 1172*). This collection, made just across the river from the type locality, includes several partly developed flowers, from which the following description is drawn.

Calyx shallowly cupulate, 3 mm. broad, less than 2 mm. high, gray-brown with 10 green nerves, the 10 teeth subequal, very short, triangular. Corolla campanulate, 3.5 or 4 mm. long, deeply parted, the lobes thickish, ovate, obtuse. Filaments less than half the length of the anthers, slender. Anthers 3 mm. long, ovate, the terminal pores projected slightly above the summit, very small, not open in my specimen, not quite reaching to the end of the corolla. Style blackish, slender, sigmoid-curved, equaling the corolla-lobes.

Accompanying my specimen, and supposed to belong with it, are the remains of a large Solanaceous fruit, resembling the pericarp of *Capsicum baccatum.* When entire, it apparently must have been 3 or 4 cm. long and wide, and I cannot regard its identity as being certain.

Lycianthes viridis

Tomentellate. Stems woody, the branchlets very slender, sulcate, very leafy. Petioles to 2 cm. long, very slender, the margins involute, reddish, like the midrib underneath. Blades to 1 dm. long and nearly 4 cm. wide, lanceolate, abruptly acuminate at the base and regularly acuminate and acute at the summit, entire, thin, deep but bright-green, sparingly puberulent above, tomentellate beneath, the slender venation slightly prominent beneath, the secondaries about 6 or 8 on each side, lightly curved and strongly ascending, the finer venation coarsely anastomosing. Cymes few- or many-flowered, the pedicels filiform, to 3 cm. long when in flower. Calyx-tube 1.5 mm. long and wide, campanulate, the 10 calyx-teeth equal, 4 mm. long, setaceous, mostly incurved at the summit. Corolla 5 mm. long, 8 mm. wide, campanulate, lobed nearly midway. Stamens 5 mm. long, nearly equaling the corolla, the filament and anther about equal in length. Anthers oblong, the summit somewhat incurved. Style simply curved, thickened upward, not equaling the stamens. Fruit not seen.

Meguilla, 3,500 feet, *O. E. White,* July 28, 1921 (*no. 439*). *Otto Buchtien, 317,* from Sirrupaya, Yungas, 2,100 meters, December 1, 1906, is probably the same, although the calyx-teeth are not so long and the corolla is larger.

SCROPHULARIACEAE

Virgularia ochrophylla

More or less scabrous, the corolla tomentose. Branches slender, strongly ascending, more or less angled, deep-purple. Leaves (only the upper seen) sessile, 2 to 2.5 cm. long, 3 to 5 mm. wide, lanceolate, the uppermost becoming linear, with narrowed base and long-acuminate and acute summit, entire, with revolute margin, thick, yellow-green, especially beneath, where the midrib is very strong and prominent. Pedicels solitary in their axils, 5 to 10 mm. long, slender, ascending. Calyx-tube 6 or 7 mm. long, 4 or 5 mm. wide, campanulate or cupulate, lightly 5-ribbed, with five alternating nerves, the teeth about two thirds the length of the tube, mostly erect, somewhat unequal, subulate, attenuate and very acute. Corolla crimson, reaching 4 cm. or more in length, the tube infundibular, slightly curved and slightly ventricose, reaching 1 cm. in breadth, the narrow portion about as long as the calyx, the limb about 1.5 cm. broad, the lobes subequal, rounded, or broader than long. Stamens exserted, the anthers oblong, 3 or 4 mm. long.

Quime, 8,000 feet, *H. H. Rusby,* July 5, 1921 (*no. 94*). "Shrubby, reaching 6 feet in height. Abundant."

BIGNONIACEAE

Arrabidaea Cardenasii

Glabrous, with the exception of the cinereous inflorescence. Branchlets rather stout, finely ribbed or nerved. Leaflets 2, one lateral wanting, the other lateral and terminal very similar. Petiole about 2 cm. long, rather stout, the terminal petiolules about equal, the lateral usually a little shorter. Blades to 8 cm. long and 6 cm. broad, the base broad and rounded, usually very slightly produced at the petiolule, the summit produced into a very short and blunt extension; thick, strongly lucid above, where the slender venation is slightly prominent, more prominent beneath, the secondaries about 6 on a side, widely spreading, little curved, the tertiaries almost transverse to the leaf axis. Panicles axillary and terminal, slenderly peduncled, the bracts at the points of branching nearly obsolete, the subulate bractlets at the base of the pedicels minute. Pedicels about 2 mm. long, slender. Calyx 3 mm. long, 2 mm. wide, campanulate-turbinate, minutely subulate-toothed, cinereous, like the branches and corolla. Corolla-tube proper scarcely exceeding the calyx, the expanded portion 7 or 8 mm. long, campanulate, not quite so long as the lobes. Stamens stout, not extending beyond the base of the corolla-lobes, and slightly exceeding the style. Appendage to the connective very short and broad, blunt, blackish. Ovary small, about twice the width of the style. Stipe of the pod biglandular at the base. Pod nearly 3 dm. long, 1.5 cm. broad, not, or very faintly ridged, closely tomentellate, the summit not acuminate, acutish or obtuse.

Rurrenabaque, 1,000 feet, *M. Cardenas,* January 24, 1922 (*no. 2037*). "In sandy loam, bearing small white flowers."

No. 735, collected without flowers, by the author, along the cataracts of the Bopi River, 3,000 feet, September 6, 1921, "growing in the edge of the forest," is evidently a form of the same. The leaflets are somewhat smaller, and not at all produced at the base, but inclined to be subcordate. The pods are about as long but distinctly narrower, smooth and shining, the slender rib on each side more prominent, the summit shortly acuminate and acute.

Arrabidaea sp.

(Specimen without flowers.) This species is very near *no. 2037,* and may be a variety of it. The leaflets are somewhat smaller, and not at all produced at the base, but inclined to be subcordate. The pods are about as long, but distinctly narrower, smooth and shining, and bear a prominent slender rib on each side, the summit shortly acuminate and acute.

Along the cataracts of the Bopi River, 3,000 feet, *H. H. Rusby,* September 6, 1921 (*no. 735*). "Growing in the edge of the forest."

Anemopaegma huachiana

Branchlets slender, minutely muricate with very small lenticels, otherwise glabrous. Leaflets 2, nearly equal and similar. Petioles to 2 cm. long, slender, the petiolules mostly a little shorter. Blades to 1 dm. long, and 5 cm. wide, lanceolate, lightly cordate, acute, thickish, deep-green, the slender venation sharply prominent on both sides, more so beneath. Secondaries 8 to 10 on each side, widely spreading, little curved, forking to interconnect at a considerable distance from the margin, connected by a fine and strong anastomosis of the veins. Panicles axillary and terminal, small and few-flowered, the peduncles longer or shorter than the leaves, the branches very minutely puberulent. Pedicel 4- to 5-angled, 5 mm. long. Calyx 6 or 7 mm. long and broad, campanulate, thickish, loosely enclosing the corolla, the margin sinuate and bearing 5 minute teeth. Corolla-tube proper exceeding the calyx by 2 or 3 mm., the expanded portion about 2 cm. long, the lobes very large and widely spreading. Stamens unequal, the longer ones reaching nearly to the base of the corolla lobes, the others 5 mm. shorter, the thecae horizontal, the connective not mucronate. Disk annular, 1 mm. high. Style shorter than the shorter stamens, the stigmas oval, broad. Fruit not collected.

Huachi, 1,800 feet, *O. E. White,* September 2, 1921 (*no. 943*). "A high climber in deep woods, the flowers developing in the sunshine at the top. Flowers light orange-yellow, very handsome, and slightly fragrant."

Anemopaegma symmetrica

Young portions, petioles, etc., minutely puberulent. Stems slender, leafy, ribbed. Petioles opposite, divaricate, slender, about 2 cm. long, the petiolules about half as long. Pseudostipules shortly stipitate, nearly orbicular, slightly mucronate, about 7 to 9 mm. broad, green, like the leaflets, which are 2 in number, the central one replaced by a slender tendril. Blades to 8 cm. long by 4 cm. broad, lance-ovate, with rounded or blunt base and abruptly short-pointed acute or obtusish summit, entire, thin, bright-green on both surfaces, the venation slender, sharply prominent beneath, the secondaries 8 or 10 on each side, falcately ascending, connected by a loose reticulation. Peduncles mostly in only one axil, about half the length of the petiole, mostly 2- or 3-flowered, subtended by 2 or more setaceous bracts which are sometimes 3 mm. long or longer. Pedicels slender, about 1 cm. long. Calyx campanulate, nearly 1 cm. long and nearly as broad, truncate, membranaceous. Corolla yellow, 4 or 5 cm. long, the narrow basal portion 1.5 cm. long, 2.5 mm. broad, the broadly infundibular throat nearly 1 cm. broad, the limb nearly 3 cm. broad, the lobes broad and rounded, 2 of them larger than the other 3. Stamens didynamous, the filaments falcate, the longer reaching to the base of the corolla-lobes. Thecae divaricate, lanceolate, obtuse, 3 mm. long. Style about equaling the stamens, the stigmas ovate, obtuse. Disk annular.

Trinidad, 800 feet, *Martin Cardenas,* March 10, 1922 (*no. 14, special*). Species near *A. sylvestris* S. Moore.

Anemopaegma Whitei

Glabrous. Branches elongate, stout, terete, gray. Petioles to 3 cm. long, stout, terete. Leaflets 2, the petiolules to 2.5 cm. long, channeled above, orange or reddish, like the midrib underneath. Blades to 8 cm. long and 4.5 cm. wide, shortly acuminate and acute, with broadly rounded or subtruncate base, thickish, deep-green, the slender venation prominent on both sides, sharply so beneath, the secondaries 6 or 8 on each side, connected with one another and with the midrib by transverse tertiaries. Panicles axillary, mostly about as long as the leaves, peduncled or branched from the base. Pedicels 2 or 3 mm. long, slender. Calyx very thin and membranaceous, the tube depressed-globose, about 8 mm. wide, the limb irregularly 3-lobed. Corolla-tube proper about 5 mm. long, narrow, the expanded portion campanulate, straight, about 2 cm. long to the base of the lobes.

Huachi, 1,800 feet, *O. E. White,* August 14, 1921 (*no. 955*). "A tall climber with magenta-colored flowers having little odor. A very profuse bloomer and very showy."

Anemopaegma leptosiphon

Glabrous. Stems slender, the stipuloid appendages not present. Leaves bifoliolate, the middle leaflet replaced by a tendril. Petioles 2 to 3 cm. long, divaricate, stout, about twice the length of the petiolules. Blade to 9 cm. long by 5 cm. wide, oval-ovate, with broadly rounded or slightly cordate base, abruptly contracted into a short, mostly obtuse acumination at the summit, entire, thick, pale-green, finely verrucose on both sides, the slender venation prominent beneath, the secondaries about 7 on each side, strongly ascending and falcate, the finer venation coarsely anastomosing. Racemes axillary, few-flowered, shortly peduncled, the pedicels about twice as long as the peduncles, recurved. Calyx 10 to 12 mm. long, about 7 mm. broad, campanulate, thickish, muricate or verrucose, the lobes short and broad, unequal. Corolla lilac-colored, about 3 cm. long when fully developed, the tube and throat of about equal length, the tube scarcely 2 mm. wide, abruptly expanded into the throat, which is 7 mm. wide, the lobes short and broad, sharply recurved.

Dissection material wanting.

Ixiamas, 800 feet, *M. Cardenas,* December 15, 1921 (*no. 1926*). "Growing in damp soil on pampa, the flowers lilac-purple." Species very near *A. symmetrica,* but well distinguished by the peculiar leaf-surface, as well as the size and form of the flowers.

Pithecoctenium glaucum

(Fruiting specimens.) Lower leaf-surfaces minutely strigose or papillose and roughish. Branches stout, pale-gray, sulcate or angled, much wrinkled in drying, bearing one or two small spheroid glands in the axil of each petiole, and occasionally one on the internode. Petioles stout, pale, angled, 3 to 5 cm. long, the petiolules similar, usually shorter, occasionally longer. Leaflets usually 2, occasionally 3 or 1, extremely variable in size, sometimes 15 cm. long by 10 cm. broad, ovate or oval, with rounded, truncate or subcordate base and an extremely abrupt acumination, which is obtuse or acutish and sometimes 2 cm. or more long; entire, thin, bright-green above, pale or glaucous beneath, 5- to 7-ribbed, with several of the lower secondaries similar to the basal ribs, all slender and sharply prominent beneath, connected by numerous slender tertiaries. Fruits shortly racemose, the peduncle and pedicels extremely stout, the pedicels 1 cm. or more long, the summits abruptly dilated, the disk hemispheric. Pod to 2 dm. long, 4 cm. broad, oblanceolate, obtuse, densely spiny, the spines brown, divaricate, about 5 mm. long, acute. Seed brown, strongly compressed, 10 to 15 mm. broad, obovate or subrotund, a ridge extending two thirds of its length, the very thin hyaline wing very broad, surrounding both sides and the summit.

Rurrenabaque, 1,000 feet, *Martin Cardenas,* January 5, 1922 (*no. 2063*).

Adenocalymna densiflora

Inflorescence tomentellate; otherwise glabrous. Branchlets stout. Only the uppermost leaves seen, the common petioles 3 cm. long, stout, ascending, the upper surface plane, the petiolules about as long. Leaflets 3, the blades 9 to 18 cm. long, 7 to 10 cm. wide, ovate with rounded base, and very abruptly, shortly and obtusely pointed summit, thin but rigid, the venation very slender, slightly prominent on both surfaces, the secondaries 10 or 12 on each side, ascending at about 45 degrees, slightly curved, connected by crooked tertiaries and by a loose reticulation. Panicle long and stoutly peduncled, densely branched, the branches angled. Pedicels slender, in flower about 1.5 cm. long. Unopened calyx ovoid, acute or shortly mucronate, in flower campanulate, 6 or 7 mm. long and equally broad or broader, coriaceous, the summit unequally and irregularly ruptured into 2 or 3 divisions. Corolla tomentose, 3.5 to 4 cm. long, the narrow basal ventricose portion 1 cm. wide, the throat curved, the limb 2 cm. broad.

Cataracts of the Bopi River, 3,000 feet, *H. H. Rusby,* September 3, 1921 (*no. 485*).

Lundia truncata

Inflorescence, petioles, and veins of the lower leaf-surfaces puberulent. Branchlets terete, gray-brown, finely costate. Leaflets 2, subequal. Petioles to 3 or 4 cm. long, slender, terete. Petiolules about a third as long, slender. Blades to 8 cm. long, 5 cm. wide, ovate with truncate, mostly oblique base and very abruptly acuminate and acute summit, very thin, bright-green above, brown beneath, where the slender venation is moderately prominent; 3- to 5-nerved from the summit of the petiole, the nerves short, the secondaries 3 or 4 on a side, widely spreading, the ends sharply up-curved, sparsely connected by crooked tertiaries. Panicles axillary and terminal, mostly small and few-flowered, the peduncles a little longer than the petioles, the bracts and bractlets nearly obsolete. Pedicels 3 to 5 mm. long, slender. Unopened buds shortly mucronate, the mucro mostly expanded into the minute teeth. Calyx regularly turbinate, with truncate summit, 6 mm. long and 5 mm. broad, ferruginous. Corolla-tube broad, exceeding the calyx, the expanded portion campanulate, nearly 2 cm. long, somewhat ventricose. Stamens unequal, the 2 longer about as long as the corolla-tube, the others about 5 mm. shorter. Connective not mucronate. Style exceeding the stamens, the stigmas ovate, thin, whitish, connate at the base to form a small concavity.

Rurrenabaque, 1,000 feet, *M. Cardenas*, January 24, 1922 (*no. 2036*). Species very near *L. phaseolifolia* Rusby.

Macfadyena violacea

(The specimen is unique and consists only of the end of a branch, bearing a pair of very young leaves and a terminal cyme of eight flowers and buds.)

Glabrous, with the exception of the inflorescence and a sparse puberulence on the veins of the lower leaf-surfaces. Branchlets very slender, herbaceous, costate or sulcate. Leaflets two, with a tendril between. Petioles 3 cm. long, very slender, like the petiolules, which are nearly 2 cm. long. Blades 8 × 3 cm., lanceolate, obtuse at both ends, thin and herbaceous, the secondaries 8 or 10 on each side, strongly ascending and lightly curved, the venation slender and obscure. Peduncle about as long as the petioles, dichotomous, the branches slender, minutely subulate-bracted. Pedicels about 1 cm. long, slender, sharply angled, bearing a pair of early deciduous bracts near the calyx, which are subulate and subscarious. Calyx cupulate-campanulate, 5 mm. long and wide, five-angled, the summit shortly, broadly, and sharply toothed, fissured on one side, ultimately to the base, membranaceous, puberulent. Corolla violet, with lighter tube, closely puberulent, broadly infundibular, 4 cm. long to the base of the lobes the contracted basal portion little longer than the calyx, the lobes rounded, nearly 3 cm. long, strongly veined. Longer filaments 2.5 cm., the shorter 2 cm. long, the thecae divergent, 2 mm. long, oblong. Styles slightly exceeding the stamens, the stigma ovate, obtuse, 1.5 mm. long. Ovary 3 mm. long, lanceolate, pubescent. Disk annular, spreading, the margin crenulate or finely sinuate.

Rurrenabaque, 1,000 feet, *H. H. Rusby,* October 7, 1921 (*no. 774*).

Jacaranda atropurpurea

Youngest portions, lower leaf-surfaces, etc., minutely puberulent. Branchlets elongate, slender, fleshy. Leaves (rather young), about 2 dm. long, the petiole about a fourth of the length, the leaflets mostly 7 or 9, opposite, about twice the length of the winged internodes, of which the wings gradually widen upward. Leaflets sessile, irregularly lance-oblong, short-acuminate at both ends, minutely mucronate, entire or obsoletely serrulate, very thin, dark-green, the venation obscure, the secondaries 6 or 8 on a side, strongly ascending. Flowers in small loose panicles from the wood, sessile or short-peduncled, the branches and flowers opposite, the bracts linear, acute, 3 or 4 mm. long, the pedicels mostly with a pair of minute bractlets above the middle, very slender, of irregular length, some nearly 2 mm. long. Calyx 5 mm. long and broad, campanulate, many-nerved, shallowly crenate, the teeth mucronate. Corolla about 6 cm. long, the tube infundibular, nearly 1 .5 cm. broad at the base of the lobes, as pressed, the lobes broad and rounded, about 1 to 1.5 cm. long, the corolla deep-purple or maroon. Anthers about half the length of the corolla, one pair a little shorter, the filaments curved, flattened, brown-purple, yellow and slightly enlarged at the summit, the base flattened and densely pilose, like the inside of the corolla-tube at that place. Thecae horizontally divergent, each about 1.5 mm. long, acuminate and acute. Disk crateriform, thick, lobed. Ovary ovoid, shorter than the calyx. Style thickish, two thirds of the length of the corolla, the stigma shortly 2-lobed, the lobes flattened.

Near Rurrenabaque, 1,000 feet, O. E. White, October 8, 1921 (*no. 862*). "A shrub to 8 feet, the flowers dark maroon-purple. Leaves reputed remedial in syphilis."

Tabebuia suberosa

(Fruiting specimens.) Branchlets short and thick, gray, exceedingly rough from crowded concave scars with thick corky margins. Petioles 5 to 10 cm. long, slender, grooved. Leaflets 5, the petiolules 2.5 to 5 cm. long, similar to the petioles. Blades 6 to 12 cm. long, 3 to 6 cm. broad, elliptic with rounded summit and base, the latter mostly a little inequilateral; irregularly sinuate-dentate, thick and rigid, finely papillose on both surfaces, drying brownish, the venation lightly prominent beneath, coarsely reticulate, the secondaries 8 or 10 on a side, crooked, widely spreading, connecting at some distance from the margin. Fruits racemose, the peduncles and pedicels very stout, deeply annulate-fissured. Follicles about 1.5 dm. long, 1.5 to 2 cm. broad as pressed, oblanceolate, obtuse, finely papillose. Seeds about 4 cm. long, including the wing, the seed body about 2 cm. long, and nearly as wide, the wing coarsely fimbriate.

On the pampas near Lake Rogagua, Bolivia, 1,000 feet, *H. H. Rusby,* November 3, 1921 (*no. 1423*). A common tree, of crooked, stunted growth, occasionally 25 to 30 feet high, the bark excessively corky-roughened, the wood light and brittle and used for rafts. Known as "cork-tree."

The above is the type, but another specimen, collected in flower, appears to be the same. The leaves are about two thirds as large. Pedicels slender, 1 cm. long, abruptly enlarged at the summit. Calyx 1.5 cm. long, 1 cm. broad, turbinate-campanulate, the mouth as in the type. Corolla 6 or 7 cm. long, the tube nearly 1.5 cm. wide, as pressed, many-nerved, yellow.

Trinidad, 700 feet, *M. Cardenas,* March 7, 1922 (*no. 26, special*). "Common tree of pampas, growing to 9 feet, with yellow flowers. The bark is different from the one that grows about Lake Rogagua." I should regard it as a mere variety of *T. suberosa.*

GESNERIACEAE

Nautilocalyx Whitei

Pilose or subtomentose, except the upper leaf-surfaces. Stems thick but weak, a foot or two long, prostrate and rooting, at least at the base, more or less angled or sulcate. Leaves crowded at the summit, the inflorescence densely crowded among their bases. Leaves 15 to 25 cm. long, 3 to 5 cm. broad, lanceolate or oblanceolate with long tapering base and acuminate and acute summit, thin, deep-green above, purple beneath, unequally short-serrate-dentate, the venation coarse but weak, the falcate-ascending secondaries 5 to 7 on each side. Bracts lanceolate, large, long-acuminate and acute. Calyx free, 5-parted, somewhat oblique, the lobes 1.5 to 2.5 cm. long, narrowly lanceolate, long-acuminate and acute, ciliate, foliaceous, 2 narrower and a little shorter than the others. Disk of two upper lobes, connate nearly to the summit. Corolla nearly 4 cm. long, consisting of a short constricted base, an ample campanulate tube and a short expanded limb, the tube being moderately ventricose near the middle and saccate at the base, the sac short, blunt and slightly falcate, the limb 5-lobed, the lobes nearly equal, short and rounded. Filaments distinct, adnate to the lower part of the corolla, dilated at the base, subcircinately curved. Anthers small, distinct, broadly oval. Ovary conic, the style filiform, shorter than the stamens, the stigma strongly 2-lobed. Flowers handsome, cream-colored.

Tumapasa, 1,500 feet, *O. E. White,* December 6, 1921 (*no. 1830*).

Drymonia Campbellii

Leaves sparingly and shortly strigose. Stems stout but weak, reclining or somewhat climbing, red, the branches short and stout. Leaves opposite, the slender petioles 1.5 to 3 cm. long, the blades 8 to 15 cm. long, 3 to 7 cm. wide, oval and somewhat oblique, acute at the base and abruptly short-acuminate and acute at the summit, irregularly and shallowly sinuate-dentate, very thin, bright-green above, pale beneath, the venation sparse and very slightly prominent beneath, the secondaries 5 or 6 on a side, falcately ascending. Peduncles solitary in the axils, slender, mostly shorter than their petioles. Calyx-lobes moderately unequal, triangular-ovate, short-acuminate and acute, somewhat oblique, entire or nearly so, foliaceous, thin, the largest 3 cm. long, more than 2 cm. broad. "Corolla white externally, brown within," larger than the calyx, the lobes broadly obovate, crenate.

Rurrenabaque, 1,000 feet, *M. Cardenas,* November 22, 1921 (*no. 1755*).

Species dedicated to Mr. Milton Campbell, President of the H. K. Mulford Company, through whose generous interest the Mulford Exploration was made possible.

Seemannia dioica

(But one specimen seen.) Densely gray-pilose, except the bright-green upper leaf-surfaces, which are very sparingly strigose with short, tapering hairs. Stems 2 dm. high, decumbent at the base, angled and sulcate. Leaves opposite, the petioles 1 to 2 cm. long, thin and weak, the blades 8 to 15 cm. long, 3 to 5 cm. broad, ovate with acuminate and acute summit and subrotund or obtuse base, entire or obscurely serrulate, ciliate, very thin, gray beneath, bright green above, the venation weak and inconspicuous, the secondaries 8 or 10 on a side, falcately ascending, faintly reddish. Flowers solitary in the axils, the peduncles very slender, 2 or 3 times as long as their petioles. Calyx-tube turbinate, about 3 mm. long and nearly as broad, the recurved lobes nearly twice as long, herbaceous, narrowly lanceolate and acuminate and acute. Corolla rose-colored, gray-pilose, 2.5 cm. long, the base slightly oblique and slightly gibbous, the tube moderately ventricose above the middle, the teeth very short, and green. Disk and pistil wanting. Stamens distinct, inserted at the base of the corolla, the base of filaments calcarate, the anthers extending to mouth of corolla, distinct.

A single specimen. Rurrenabaque, 1,000 feet, *M. Cardenas,* January 29, 1922 (*no. 2038*).

The anomaly of a unisexual plant in this family is difficult of explanation. The plant is technically a *Seemannia,* by its corolla teeth, and calcarate filaments, while its distinct but connivent anthers are exceptional in this genus. It may be an abnormality, possibly a hybrid with an *Achimenes.* The fact that only one specimen could be found is suggestive of an abnormal origin.

Corytholoma paludosa

Closely and somewhat harshly tomentellate throughout. Rhizome elongate, apparently not scaly. Stems to a meter high, erect, slender, mostly simple, sparsely leafy, reddish, terete or slightly angled or sulcate in places. Leaves opposite or ternate, the lowest, if present, very small and rudimentary, but green; those of the middle portion of the stem sessile, to 8 cm. long and 3 cm. wide, obtuse at both ends, finely crenate, thick and somewhat fleshy, bright-green above, gray beneath, where the venation is very strong and more or less reddish, very strongly and crookedly anastomosing. Floral leaves reduced to ovate, thick, green, rigid bracts. Peduncles one-flowered, solitary in the axils of the bracts, erect, nearly 2 cm. long, slender. Calyx-tube hemispheric, 6 to 9 mm. broad, shorter than the triangular-acuminate, subequal rigid erect or slightly spreading calyx-lobes. Corolla scarlet, densely gray-pubescent, 3 cm. long, the greatest width, as pressed, 8 mm., the upper lip erect, about 8 mm. long, the lower lip very short, recurved-spreading. Basal gibbosity of corolla 3 mm. long, oval, erect and appressed. Corolla ventricose to about the middle, or a little higher, slightly contracted above. Middle lobe of the lower lip 5 mm. broad, and not so long, the lateral lobes much broader. Upper lip about 1 cm. broad, deeply emarginate, somewhat narrowed at the base. Stamens moderately exserted, the anthers all coherent, but easily separable in pairs. Filaments attached at the base of the corolla. Two posterior glands of the disk large, slightly emarginate, subconnate, the lateral glands closely adjacent, ligulate, the anterior very small. Ovary conic, 5 mm. long, pubescent, like the style, which at length exceeds the stamens. Stigma shortly 2-lobed, recurved.

Ixiamas, 1,500 feet, *O. E. White,* December 13, 1921 (*no.* 1111); near Reyes, *White,* October 25 (*no. 1534*). "Growing in bog-land, associated with a white orchid and grasses and sedges. Flowers orange-scarlet."

ACANTHACEAE

Mendoncia robusta

Entire plant yellowish by a dense covering of short mostly appressed hairs, the upper leaf-surfaces scabrellate with minute tufts. Stems quadrangular, stout. Petioles 3 to 5 cm. long, rather stout, erect, the base sharply upcurved and incurved, in age becoming elongate and reflexed and twisted. Blades thick, 8 to 15 cm. long, 5 to 10 cm. wide, ovate, acute, with rounded base, entire, the midrib and secondaries lightly prominent above, strongly so beneath, the secondaries 4 or 5 on a side, ascending and lightly curved, connected by slender tertiaries, the smaller venation inconspicuous. Leaves on young shoots much larger and narrower, oval or somewhat obovate, on shorter petioles, the base slightly cordate. Peduncles one or two, stout, shorter than the petioles. Bracts at length about 3 cm. long and broad, oval with the summit rounded or subtruncate and minutely mucronate, the midrib very strong, the secondaries prominent and stout, interarching near the margin. Flower (but one seen) twice the length of the bracts, apparently dark-red. Immature fruit wholly enclosed in the bracts, tipped with the long, slender, twisted style.

Rurrenabaque, 1,000 feet, *M. Cardenas,* October 6, 1921 (*no. 808*).

var. (?) alba

Stems slender. Leaves shorter and relatively broader, abruptly very short-acuminate at both ends, thin. Flowers white. Bracts and fruit similar to those of the preceding, but smaller.

Collected at the same time and place as the last, by the same collector, who regarded them as distinct species. Whether this is a distinct species, or a mere variety of a polymorphous one, is a question that must await further information.

Ruellia serratitheca

Subglabrous, the scattered whitish hairs short, minute, appressed, the stems quadrangular and sulcate. Petioles 1 to 2 cm. long, slender, channeled, the bases of the younger ones connected by an interpetiolar line. Blades 7 to 15 cm. long, 3 to 6 cm. broad, ovate, acuminate and acute, the base abruptly and slightly produced into the petiole; lightly and irregularly sinuate-dentate, bright-green, thin, the slender venation prominent beneath, the secondaries about 7 on a side, moderately ascending and lightly curved and connected by numerous straightish tertiaries. Panicles axillary, on very long and slender peduncles, small, narrow and few-flowered, the subconnate bracts linear, elongated. Calyx 5 mm. long, the tube cupulate, very short, the teeth linear-setaceous, subequal. Corolla bright-yellow, the narrow cylindric tube a half longer than the calyx, abruptly inflexed above, the upper portion 2 cm. long, campanulate, slightly contracted at the mouth, the lobes erect, very short, obtuse. Lower portion of filaments connate in pairs, the anthers subexserted, one theca minutely serrate on the margin.

Canamina, 4,500 feet, *H. H. Rusby,* July 28, 1921 (*no. 363*).

Ruellia multisetosa

(Aphragmia.) Leaves minutely strigose, the inflorescence hirsute. Branches sharply quadrangular. Petioles about 2 cm. long, stout, channeled above, mostly recurved. Blades to 1.5 dm. long, 5 cm. broad, ovate, with base abruptly narrowed into the petiole and abruptly acuminate and acute summit, obscurely sinuate-dentate, thick and drying brown, the midrib lightly grooved above, prominent beneath, the slender secondaries about 10 on each side, strongly falcate-ascending. Flowers crowded at the ends of the branchlets, their bracts and bractlets simulating an involucre. Bracts about 2 cm. long, ovate, long-acuminate, the bractlets similar but terminating in attenuate acuminations, the calyx-lobes similar, all whitish-hirsute. Corolla-tube nearly 1 cm. long, 3 mm. broad, constricted at the summit. Throat campanulate, nearly 3 cm. long, 1.5 cm. broad at the summit, the lobes subequal, 1.5 cm. long, 1 cm. broad. Stamens didynamous, the longer pair reaching nearly to the base of the corolla-lobes, the others a little shorter, the anthers 3 mm. long, 2 mm. broad, sagittate.

Huachi, 1,800 feet, *O. E. White,* August 13, 1921 (*no. 437*). "A tree, to 15 feet high, in forest, the flowers lilac-purple."

Also collected by H. H. Rusby farther up the Bopi and regarded as the most beautiful flowering shrub seen on this journey.

Ruellia hypericifolia

Finely and very shortly strigose, the lower leaf-surfaces somewhat tomentellate. Stems slender, erect or ascending, branched, leafy to the summit, the branches sharply quadrangular. Leaves 2 to 5 cm. long, 5 to 15 mm. wide, lanceolate or varying to oblanceolate, obtusish with acuminate subsessile base, entire, grayish-green, or slightly brownish beneath, where the thick midrib and 5 or 6 pairs of crooked strongly ascending secondaries are prominent. Flowers solitary in the axils, subsessile, the calyx tube very short, the slightly unequal lobes narrowly lanceolate and attenuate at the summit, subcarinate at the base, the largest to 12 mm. Corolla lilac, about 3 cm. long, the lower half of the tube narrowly cylindric, mostly straight, the upper half campanulate, the large, broadly recurved lobes widely spreading or recurved. Filaments attached at the summit of the cylindric portion of the tube, the longer stamens nearly as long as the corolla, the shorter ones only about half as long. Anthers large, lanceolate, lightly cordate. Style 2.5 cm. long, very slender. Capsule obovoid, light-brown, nearly equaling the calyx-lobes.

Near Reyes, 1,000 feet, October 26, 1921 (*no. 1322*).

Aphelandra cryptantha

Stem and inflorescence densely white-pilose, with spreading hairs, the lower leaf-surfaces sparsely and the upper still more sparsely so. Leaves sessile, or the lower with extremely short broad petioles, the upper (only ones seen), 1 dm. or more long, 4 or 5 cm. wide, oblanceolate, terminating in a small spine, the upper fourth of the margin entire and ciliate, the lower three fourths spinose-dentate, the teeth successively larger and more spinose toward the base; thin but rigid, deep-green above, paler or yellowish beneath, where the midrib and secondaries are somewhat prominent, the latter 8 or 10 on a side, slender, moderately spreading and lightly curved. Spike terminal, single and simple, more or less peduncled, about 3 cm. broad, extremely dense. Bracts about 2 cm. long and 6 mm. wide, brown, lanceolate, acuminate and very acute, bearing about 4 long-attenuate pungent spines on each side. Flowers entirely concealed by the bracts. Sepals ciliate, the largest 1 cm. long and 4 mm. wide, oblong, acute, two others slightly longer and only half as wide, lanceolate, the fourth much shorter and narrower, lance-linear. Corolla a little longer than the calyx, red at the summit, yellowish below, the tube straight and equal, the lips nearly equally 3 mm. long, the upper erect, entire, ovate, obtuse, the lower 3-lobed, the lobes broadly ovate, obtuse. Filaments attached at the base of the corolla, the deep-red anthers reaching the base of the lips, 3.5 mm. long, minutely muticous. Style equaling the stamens, the stigma minutely 4-lobed. Capsule 1 cm. long.

An imperfect specimen of this plant, collected by Otto Kuntze, at Santa Cruz, in May, 1892, was determined by Dr. Lindau as *A. Rusbyi* Britton, but the excellent specimens collected at Huachi, 1,800 feet, *O. E. White,* August 12, 1921 (*no. 542*), show clearly that the species is distinct.

Aphelandra albadenia

Minutely and sparsely puberulent-strigose with whitish hairs, but the entire plant of a deep-green color and densely leafy. Stem subterete, the internodes short. Leaves 1.5 to 3 dm. long, 3 to 6 cm. wide, long-acuminate at both ends, especially at the base, which tapers into a short margined petiole; entire or obscurely sinuate-crenate, very thin, deep green on both sides, the inconspicuous venation very slender, the secondaries 12 to 15 on a side, falcately ascending. Spikes peduncled in the upper axils, about 1 dm. long, 2 cm. wide, lanceolate, the scales 2 cm.

long, 4 to 5 mm. wide, oblong, acute, ciliate, green, thin. Sepals long-pilose, the largest 2 cm. long, narrowly lanceolate, long-acuminate, the others a little shorter, lance-linear with long-attenuate summit. Corolla nearly 5 cm. long, pubescent, yellow, the erect upper lip 1.5 cm. long, the lower a little longer, spreading, nearly equally 3-lobed, the lobes very short, rounded at the summit. Stamens nearly equaling the upper lip, the filaments attached at the base of the corolla, dilated at the base, two of them attached together. Anthers of the two longer stamens muticous at the base, the others caudate, the tails ending in white, curved, sac-like glands. Style terminating in a slender, divergent white tip.

This very peculiar species was collected by myself at Reyes, 1,000 feet, in June, 1886, and distributed as "*Aphelandra* sp. (?)." It was again collected at the cataracts of the Bopi River, 1,800 feet, *O. E. White,* August 8, 1921 (*no. 442*). It is quite distinct from every other species by its peculiar foliage and especially in its glandular-caudate stamens, in allusion to which it is named.

Schaueria azaleaeflora

Roughly grayish-hairy throughout, the hairs extremely short. Branchlets slender, woody, terete, striate. Petioles 3 to 5 mm. long, slender, the blades 4 to 8 cm. long, 1 to 2.5 cm. broad, inequilaterally oblong and short-acuminate at both ends, very thin, grayish-green, scabrescent, the slender venation not prominent, or slightly so beneath, the secondaries about 5 on each side, ascending, lightly curved, the remaining venation obscure. Spikes mostly simple at the ends of the branchlets, short and dense, the flowers creamy-yellow, showy, 4 to 5 cm. long, the minute bracts subulate. Calyx-tube scarcely any, saucer-shaped, the lobes 3 or 4 mm. long. Tube of corolla somewhat longer than the lips, infundibular, the lower third abruptly contracted and its base very abruptly dilated. Upper lip erect, entire, concave, the lower a little longer, strongly recurved, 3-lobed, the lobes about a third of its length, oblong, obtuse, 3-nerved. Stamens a little shorter than the upper lip, attached near the middle of the tube. Anther-cells parallel, equal, sagittate, the lobes about as long as the body, lightly curved at the ends. Style a little exceeding the stamens, obtuse. Disk cupulate, lightly lobed.

Covendo, 1,800 feet, *O. E. White,* August 23, 1921 (*no. 990*).

Stenostephanus boliviana

Veins of the lower leaf-surfaces, inflorescence, etc., puberulent. Branchlets slender, quadrangular, sulcate. Leaves to 3 dm. long, 1.5 dm. wide, ovate, abruptly contracted into an acuminate, subsessile base and into a short acute terminal acumination, entire, thin, very sparsely and minutely strigose above, puberulent on the veins beneath, the secondaries about 15 on each side. Inflorescence terminal, thyrsoid. Bracts ovate, acuminate, rigid, the bractlets smaller and narrower. Pedicels 1 to 2 mm. long. Calyx-tube crateriform or nearly hemispheric, 2 mm. wide, after anthesis becoming contracted above the ovary and depressed-globose in form. Calyx-teeth 3 mm. long, subulate and attenuate from the base. Narrow portion of the corolla-tube about equaling the calyx, slightly enlarged upward, then abruptly dilated into the ventricose throat, which is 1 cm. long and 8 mm. broad, slightly curved and with the mouth slightly contracted. Upper lip of corolla 5 mm. long, narrow, entire, erect or recurved, the lower lip shortly 3-lobed, the middle lobe a little smaller, the lobes ovate, obtuse, about 3 mm. long. Stamens 2, attached to the base of the corolla, exserted, more than twice as long as the corolla, one shorter than the other and with a smaller anther. Anthers 1-celled. Style filiform, about equaling the stamens, the stigma small, entire.

Ixiamas, 1,500 feet, *Martin Cardenas,* December 12, 1921 (*no. 1905*).

Dianthera graminifolia

Sparsely short-puberulent. Stems slender, simple or branched from the base, weak, irregularly angled, erect or ascending. Leaves sessile, tapering into a short petiole-like base, very unequal, the upper usually longer, to 7 cm. long and 5 mm. broad, lanceolate, acuminate, obtuse or obtusish, entire, thin, deep-green, roughish with sparse, very short hairs on margin and midrib, the venation obscure, the secondaries about 7 or 8 on each side, strongly falcate-ascending. Spikes axillary, mostly exceeding their leaves, very slender, long-peduncled. Bracts to 1 cm. long, linear, attenuate. Calyx at length nearly 1 cm. long, divided to the base, the lobes subequal, lance-linear, attenuate, the midrib prominent. Open corolla more than twice the length of the calyx, bluish-purple. Dissection material wanting. Capsule light-brown, exceeding the calyx, broad, acute, the base contracted.

In shallow water about Lake Rogagua, 1,000 feet, *H. H. Rusby,* November 3, 1921 (*no. 1421*), the type; Ixiamas, 800 feet, *O. E. White,* December 19, 1921 (*no. 2310*). Dr. White says "Flower magenta-colored, with deep magenta spots on throat and lip."

Beloperone viridissima

Inflorescence, etc., pubescent with spreading hairs, the foliage bright-light-green, minutely and sparsely white puberulent, the stems pale-green, very leafy. Leaves 2 to 4 dm. or more long, 4 to 8 cm. broad, oval, obovate or oblanceolate, abruptly acuminate and acute, gradually tapering into a short margined petiole-like base, lightly and irregularly sinuate-dentate, thin, the midrib mostly channeled above, prominent beneath like the slender secondaries, which are 10 to 15 on a side, strongly falcate-ascending, lightly connecting almost at the margin, the connecting reticulation sparse and very slender. Panicles terminal, long-peduncled, ample, much-branched, the branches strongly ascending, mostly subtended by setaceous-linear bracts, like those of the sessile flowers, the floral bracts mostly a little more than half the length of the calyx. Calyx-tube cupulate, very short, the lobes about 5 mm. long, one a little larger, narrowly lance-linear and long-attenuate. Corolla-tube 2.5 cm. long, lightly curved, narrowly infundibular, the basal portion contracted. Lower lip 1.5 cm. long, narrow, minutely 3-toothed, the teeth obtuse. Upper lip a little shorter and much broader, concave. Stamens almost equaling the upper lip, the style exceeding it, obtuse. Fruit not seen.

Huachi, 1,800 feet, *O. E. White,* August 13, 1921 (*no. 550*).

RUBIACEAE

FLEXANTHERA gen. nov.

Calyx-tube turbinate, the limb abruptly expanded, short, five-lobed, imperfectly deciduous. Corolla campanulate, five-lobed, valvate-induplicate, the terminal portions more or less concave and pubescent within. Stamens five, borne about the middle of the corolla-tube, exserted, the filaments dorsally flattened, pilose at the base, the anthers oblong, compressed, basally attached, sagittate, at length reflexed and recurved, completely laterally dehiscent. Ovary two-celled, the placentae elongate, fleshy, centrally affixed by the lower half, the numerous ovules imbedded in the surface. Style exserted, upwardly thickened, shortly two-lobed, the stigmas rounded. Disk tumid, hemispheric but the summit concave. Type, *Flexanthera subcordata* Rusby.

A tree, with opposite, ovate, ample leaves, and small terminal panicles. A single imperfect capsule is two-celled, oblong, compressed and with thick pericarp. Stipules not seen. The genus is allied to *Rustia,* from which it differs in its smaller flowers, reflexed and recurved dehiscent anthers and deciduous calyx-limb and in the character of its placentae.

Flexanthera subcordata

Glabrous, the branchlets terete and stout. Petioles 1 to 2 cm. long, stout, subterete, the blades 10 to 25 cm. long, 6 to 18 cm. broad, ovate and somewhat rhomboid, the base lightly cordate, the summit short-acuminate and acute; membranaceous, deep-green on both sides, with the slender venation strongly prominent underneath. Secondaries 15 to 20 on a side, widely spreading, and falcately connecting near the margin. Panicles terminal, solitary, (in one case two), five to seven cm. long inclusive of the short, stout peduncle, loosely flowered, the flowers sessile or the ovary tapering into a very short pedicel. Calyx 4 mm. long, the lobes half as long as the tube and broader than long, with rounded summits. Corolla 6 mm. long, the lobes one fourth of the length, at length somewhat spreading, their summits lightly concave and slightly pubescent. Filaments, when fully extended, nearly twice the length of the corolla, attached about the middle of the tube, pilose at the base, flattened, broadest at about the middle and again broadened at the point of attachment to the anthers, which is just back of the sinus. Anthers about as long as the corolla-lobe, linear-oblong, at length reflexed and recurved. Style equaling or exceeding the filaments, thickened upward, shortly two-lobed, the stigmas rounded.

East of Bonda, Colombia, in the month of July, *Herbert H. Smith* (*no. 2404*). "A tree to 40 feet in height."

Mr. Smith regards this as distinct from his *no. 92,* by virtue of its longer stamens. Further information in regard to this is necessary. The filaments appear to elongate irregularly during anthesis, and it is possible that a dimorphic condition may exist.

Flexanthera fragrans

Peduncles and inflorescence puberulent, the branchlets rather stout, leafy. Stipules deciduous, not seen. Petioles about 8 mm.

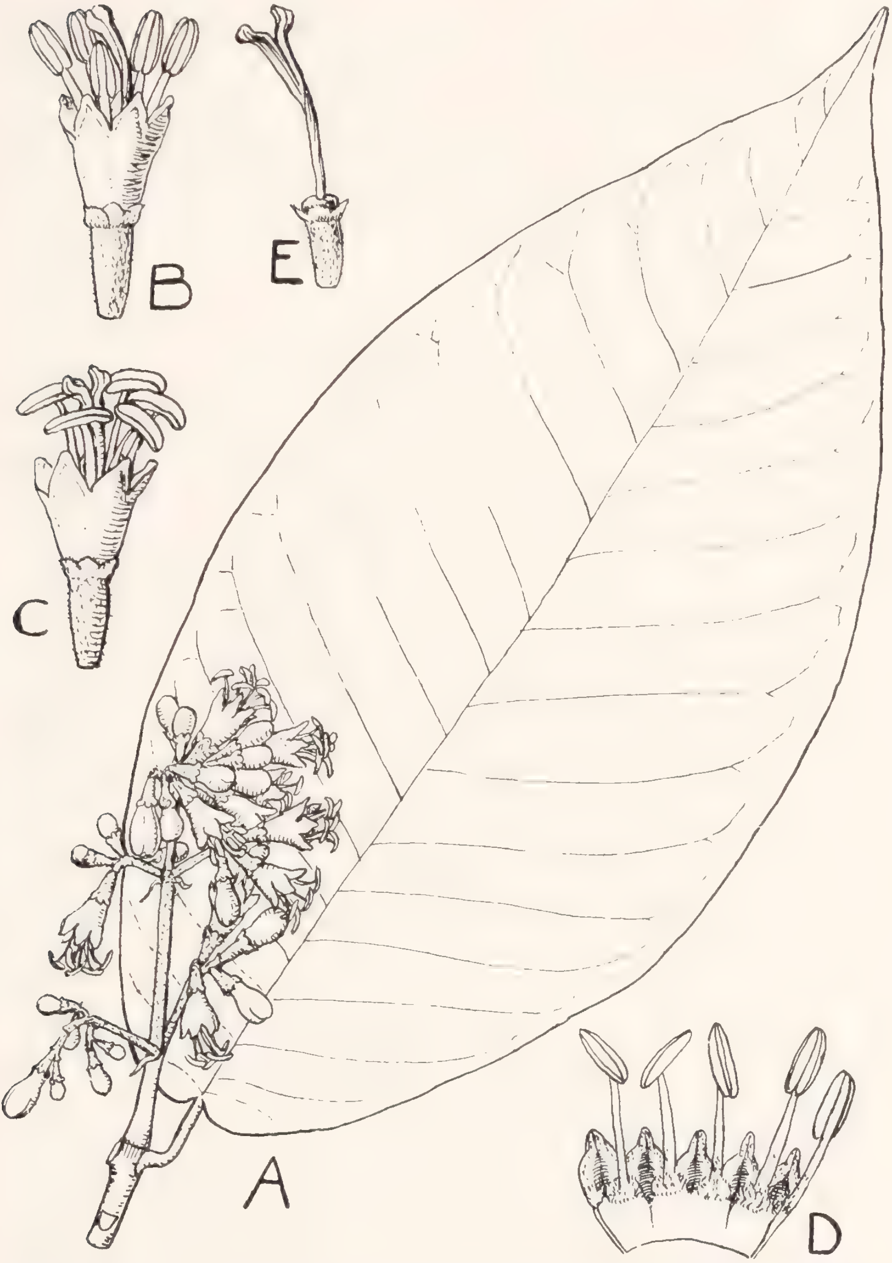


FIGURE 6. *Flexanthera subcordata* Rusby. A, leaf and inflorescence; B, single flower in young state, × 2; C, the same when older, with anthers reflexed, × 2; D, inner view of mouth of corolla, with pilose lobes and stamen attachment, × 2; E, calyx, with disk and style, × 2.

long, stout, recurved. Blade 12 to 18 cm. long, 5 to 8 cm. wide, ovate, with round or subcordate base, short-acuminate, obtuse, bright-green on both sides, the secondaries 14 to 18 on each side, the outer portions strongly falcate, connecting very close to the margin, connected by very numerous curved tertiaries, the venation strongly and finely anastomosing, prominent on both surfaces. Peduncles 2 to 4 cm. long, stout, quadrangular, reddish, shorter than the panicles, which are densely flowered at the ends of the branchlets. Bractlets minute. Flowers subsessile, the calyx-tube infundibular, about 2.5 mm. long, the limb 1.5 mm. broad, the very short, broadly ovate obtuse teeth erect and appressed, short-ciliate. Corolla fleshy, the tube about 3 mm. long and nearly as broad, the limb a little shorter, 4-lobed, the lobes broadly ovate, obtuse, erect, subcarinate. Corolla wholly puberulent on both surfaces. Filaments attached about the middle of the tube, short-pilose, dilated below, the exserted portion somewhat recurved, nearly as long as the corolla. Anthers reflexed, oblong, longitudinally dehiscent, cordate, the lobes rounded. Style about equaling the stamens, stout, upwardly thickened, short-pilose, the stigmas 2, sharply truncate. Disk tumid, hemispheric, blackish or deep-purple.

San Buena Ventura, 1,000 feet, *M. Cardenas,* December 1, 1921 (*no. 1738*). "A small shrub on river-margin. Flowers white, very fragrant."

Macrocnemum hirsutum

Inflorescence and lower surfaces of the young leaves short-hirsute. Branchlets short, stoutish, obtusely angled, enlarged at the upper portions of the internodes, leafy. Stipules caducous, to 3 cm. long and 1 cm. broad, oblanceolate, with rounded summit, thickish, brown or purplish. Petioles unequal, to 2 cm. long. Blades to 13 cm. long and 5 cm. broad, obovate, with mostly obtuse base and a very short, broad, obtuse point at the summit, entire, thick, drying brownish, the midrib channeled on the upper surface, prominent beneath, as are the slender secondaries, which are about 10 or 12 on each side, mostly scrobiculate in the axils, spreading at an angle of about 45 degrees, and lightly curved towards the end, connected by few crooked tertiaries. Panicles in the upper axils, rather small, long-peduncled, the bractlets subulate, very small, the hairs somewhat ferruginous. Flowers sessile or subsessile. Calyx-tube infundibular, about 7 mm. long, finely nerved, the limb about 2 mm. broad, shallowly lobed. Corolla-tube about 8 mm. long, infundibular, 10-nerved, slightly enlarged about the middle, the lobes 5 mm. long, broad, obtuse, thick, tomentose on the inside. Filaments 8, 5 with anthers, attached a little above the middle of the tube, unequal, the longest 5 mm. long, tapering upward, the lower portion flattened and densely pilose, the anthers rounded, small. Disk black, 1 mm. high, thick and fleshy, the margin sinuate. Style 8 mm. long, filiform, the stigma clavate.

Rurrenabaque, 1,000 feet, *H. H. Rusby,* October 15, 1921 (*no. 1296*).

Duggena Whitei

Densely pubescent with yellowish-gray hairs, those of the stem divergent or slightly reflexed, the upper leaf surfaces rather sparsely strigose. Stems tall and slender, with elongate internodes, terete. Interpetiolar stipules entire, more than twice the length of the petioles, subulate with long-attennate summit. Petioles 2 to 4 mm. long, rather stout. Blades 7 to 14 cm. long, 2 to 6 cm. broad, ovate, with obtuse base and acuminate and acute summit, entire, thin, deep-green and somewhat strigose above, yellowish-gray beneath, where the slender midrib and strongly ascending secondaries, about 10 to 12 on a side, are lightly prominent, the venation scanty and obscure. Panicle in my specimen about 2 dm. long, long-peduncled, the peduncle and rachis stout. Bracts narrowly linear-attenuate, unequal, mostly longer than the longest pedicels, which, in flower, are about 3 mm. long, slender and mostly divergent, the flowers mostly in threes. Calyx nearly as long as the pedicel, the tube broadly ovoid or subglobose, about as long as the longest tooth, the 4 teeth subulate and acuminate. Corolla puberulent, the tube 4 or 5 mm. long, very slender, the throat moderately enlarged, the 4 lobes three fourths as long as the tube, oval, thickish, widely spreading. Anthers and style reaching beyond the middle of the tube, the stigma entire, truncate.

Specimen without collection date (*no. 1294 A*). It may be the same as *no. 2350,* collected at Rurrenabaque, Bolivia, *O. E. White,* January 13, 1922, although its flowers are more slender.

Sabicea acutissima

Tomentellate throughout. Branches elongate, stoutish, terete, gray. Stipules 1 cm. long, 6 mm. broad, ovate from a broad base, acute, reflexed, herbaceous, and colored like the leaves. Petioles to 2 cm. long, the narrow margins involute, mostly reflexed. Blades to 15 cm. long and 6 cm. wide, ovate, with the base abruptly and shortly produced into the petiole, abruptly short-acuminate and very acute at the summit, entire, deep-green above, gray and very softly tomentellate beneath, the slender midrib and secondaries lightly prominent above, the latter 10 to 12 on a side, strongly ascending and slightly curved, the slender venation obscure, densely anastomosing. Peduncle in only one axil of a node, shorter than the petiole, the cyme hardly 2 cm. broad, densely flowered, the hirsute flowers subsessile. Calyx-tube 3 mm. long, campanulate, the lobes somewhat longer, narrowly lanceolate, acutish, widely spreading, about equal, longer than the corolla-tube, not equaling the corolla-lobes, which are ovate, acutish, recurved.

Rurrenabaque, 1,000 feet, *M. Cardenas,* November 25, 1921 ("*no. 1185.*" There is apparently a confusion of numbers, as I have *1185* recorded as a "*Bassovia* 8 to 10 feet high, with white flowers").

Watsonamra sordidiflora

Glabrous, the branches elongate and slender, terete. Stipules distinct, 5 to 8 mm. long, ovate, obtuse. Petioles 1.5 to 3 cm. long, the margins strongly upcurved. Blades 1 to 3 dm. long, 5 to 12 cm. wide, varying from lance-ovate to oval, obtuse, the largest ones entire, the smaller upper ones, or some of them, very irregularly erose-toothed or erose-pinnatifid, all thin and membranaceous, the slender venation prominent, the secondaries 15 to 20 on a side, lightly falcate-ascending, sparsely connected by tertiaries. Panicles terminal, shortly and stoutly peduncled, the peduncles somewhat quadrangular, the inflorescence lax, the ultimate branches and pedicels erect or nearly so, the inflorescence and flowers of a cherry-red color. Pedicels slender, somewhat thickened upward, some of them 1 cm. long, subtended by very small rigid, attenuate bractlets. Calyx-tube, in flower, about 1.5 mm. long, irregularly turbinate, lightly angled, the limb about 2 mm. broad, abruptly spreading or lightly recurved, crenately 5-lobed, the blackish hemispheric disk conspicuously projecting. Open flowers not seen, the buds densely yellowish-scurfy-tomentose, about 1 cm. long and nearly half as broad, somewhat clavate, with rounded summit and truncate or umbilicate base. Stamens attached below the middle of the corolla, at the top of a pilose band, the filaments slender, nearly half as long as the linear anthers, which are attached at about the middle of the back, and extend to the base of the corolla lobes. Style filiform, slightly thickened upward, the branches a fourth of the total length, flattened, enlarged at the summit, puberulent. Very young fruit ovoid, coarsely 9- or 10-ribbed, the ribs rounded, and bearing the calyx-teeth and prominent black disk.

Rurrenabaque (San Buena Ventura), 1,000 feet, *M. Cardenas,* November 26, 1921 (*no. 1190*). "A slender shrub, to 12 feet high, in forest."

Basanacantha erythropoda

(Fruiting plant.) Glabrous, except the venation of the lower surface of young leaves. Branchlets short, stout, terete, of a light reddish-brown color, mostly bearing a pair of pungent spines at the end, the outer bark exfoliate. Stipules small, obscure caducous. Leaves sessile, to 8 cm. long and 3 cm. broad, obovate, with acuminate base and abruptly very short-pointed, acutish summit, entire, thin, pale green, the midrib on the lower surface minutely short-hairy when young, the slender secondaries about 6 or 8 on a side, forking above the middle, the branches looped together at some distance from the margin. Flowers not seen. Fruit terminal, solitary, the peduncle about 1 cm. long. Fruit globose, to 2.5 cm. in diameter, purple, finely verrucose, bearing the calyx-limb, its cylindric portion 2 mm. long, the 4 lobes 2 or 3 mm. long, spreading, acute. Seeds not numerous, strongly compressed, blackish, obscurely triangular in outline, 6 to 8 mm. broad.

Huachi, 1,800 feet, *O. E. White,* September 3, 1921 (*no. 1003*). The same species was collected by Dr. White without flowers or fruit at Rurrenabaque, 1,000 feet, November 25, 1921, as the host of a parasitic fungus (*no. 1806*).

Basanacantha mucronata

(Pistillate plant.) Nearly glabrous. Branchlets stout, terete, divaricate, gray, the flowers densely crowded at the summit. Stipules 6 or 7 mm. long, and nearly as broad, imbricated, brown, ovate, keeled, obtuse but with the end of the keel slightly projecting. Petioles about 1 cm. long, narrowly margined, slender, the blades to 12 cm. long and 6 cm. broad, ovate with the base abruptly contracted into a short and broad acumination and abruptly short-acuminate at the summit, which is minutely mucronate; entire, thin, bright-green on both sides. Secondaries

8 to 10 on each side, slender, lightly prominent on both sides, widely spreading, little curved, the venation obscure. Calyx-tube wanting, the lobes lanceolate, acute. Corolla fleshy, pilose, the tube 6 mm. long, filiform, the lobes 5 (occasionally 6), 2 or 3 mm. long, widely spreading, lance-oblong, strongly and sharply mucronate, the sinuses broad, obtuse. Stamens wanting. Stigmas exserted, large, capitate, 2-lobed. Fruit (immature) oval, more than 1 cm. long and nearly as broad, brown, minutely downy, tipped by the persistent calyx, much wrinkled and apparently fleshy and larger when fresh.

In the gorge of the Bopi River, 3,000 feet, *H. H. Rusby,* September 9, 1921 (*no. 555*). A small tree on the river bank, the white flowers very fragrant.

So far as can be determined from the material at hand, *Williams, 527,* from Tumapasa, 1,800 feet, December 13, 1901, is of this species. This specimen bears the mature fruit, which is nearly spheric, 2 cm. long and slightly broader, finely verrucose, the calyx wanting and the summit bearing an undulate annulus which is probably the disk, but may be the base of the calyx-limb.

Basanacantha macrocarpa

(Fruiting specimen.) Principal veins of the lower leaf surfaces roughish with few very short hairs. Branchlets slender, rigidly ascending, terete, gray, some spinose when young. Stipules 3 to 4 mm. long, thick and rigid, ovate, keeled, the keel extended into a pungent awn that is sometimes as long as the body. Petioles 3 mm. to 1 cm. long, margined. Blades 4 to 7 cm. long, 1.5 to 3 cm. wide, oval or slightly obovate, with slightly produced acute base and obtuse summit, entire, thin but rigid, pale-green, the midrib and secondaries lightly prominent on both sides, the latter 6 to 8 on a side, strongly falcate, the venation obscure. Fruiting pedicel 3 cm. long, stout, rigid and straight, spreading, thickened upward. Fruit nearly 6 cm. long, 1.5 cm. broad, oblanceolate, 10-costate, the ribs slender, the short-tubular portion of the calyx-limb persistent, the lobes broken off in my single specimen. Fruit 2-celled, many-seeded, the seeds horizontally attached to the thin septum, compressed, imperfectly triangular, nearly 1 cm. long and more than half as broad, dark reddish-brown, the surface minutely granular.

Rurrenabaque, 1,000 feet, *M. Cardenas,* October 12, 1921 (*no. 1261*). "A shrub in the forest."

My specimen of this plant is very imperfect, consisting of 2 branches, one leafy, the other bearing a single fruit. Its stipules are not typical of *Basanacantha,* but the fruit and seeds are.

Basanacantha mollis

(Pistillate plant.) Gray-pubescent. Branchlets rather stout, spreading, leafy and spiny only at the ends. Spines about 1 cm. long, pungent. Stipules 6 mm. long, ovate, thin, brown, nerved, keeled, cuspidate. Petioles 1 cm. long, broad. Blades to 1 dm. or more long and half as wide, abruptly short-acuminate at both ends, very thin, entire, or obsoletely dentate near the summit, pale-green above, gray beneath, the venation not prominent, the secondaries 10 or 12 on each side, widely spreading, then falcate. Cymes terminal, sessile, few-flowered. Pedicels filiform, 1.5 to 2 cm. long. Calyx-tube 3 mm. broad, shortly and broadly turbinate, 5-lobed, the lobes 3 or 4 mm. long, narrow with attenuate summit. Corolla-tube 2 cm. long, slender, narrowed upward, 10-sulcate, the limb 2 cm. broad, widely spreading. Anthers 2 or 3, imperfect, nearly sessile in the throat of the corolla, 3 mm. long, oblong. Stigmas 3, a little exceeding the stamens, 2 mm. long, shovel-shaped, the style filiform.

Rurrenabaque, 1,000 feet, *H. H. Rusby,* October 12, 1921 (*no. 1255*). "A shrub, in the forest."

Alibertia Tutumilla

Glabrous, excepting the flowers. Branchlets short, rather stout, reddish-brown, roughened with leaf scars, very leafy. Stipules nearly 1 cm. long, connate at the base, thin, brown, caducous, leaving a very shortly setose base surrounding the stem. Petioles nearly 2 cm. long, reddish, like the midrib, rigid, strongly channeled above. Blades to 2 dm. long, and 8 cm. broad, lance-oblong, the base tapering into the petiole, acuminate and acute at the summit, entire, thickish and rigid, deep-green, somewhat shining, the slender venation prominent beneath, the secondaries about 12 to 14 pairs, the lower opposite, more or less decurrent on the midrib, widely spreading, the outer portions strongly curved. Flower terminal, subsessile, solitary, subtended by 2 or more broadly ovate bracts resembling the stipules. Calyx-tube 7 mm. long, 5 or 6 mm. broad, obovoid, somewhat constricted at the summit, the limb about as long and broad, the base slightly dilated, darker than the upper cylindric portion, which is finely many-nerved, truncate, with six extremely short lobes. Corolla minutely gray-downy on both surfaces, the tube 1 cm. long, stout, enlarged above, the lobes 1 cm. long, ovate, acutish, thick. Fruit nearly spheric, 4 cm. broad, on a stipe 5 mm. long and 1 cm. broad, dark-brown, glabrous, bearing the persistent calyx-tube, about 5 mm. long and broad, with a thick epigynous disk at its base. Pericarp crustaceous. Seeds imbedded in a pulp of peculiar, sweet and slightly acid agreeable flavor, the seeds lenticular, slightly obovoid, 7 mm. long, light-brown.

Rurrenabaque, 1,000 feet, *O. E. White,* January 27, 1922 (*no. 2354*). "A tree 30 to 40 feet high, in wet forest, and cultivated. Flowers bright creamy-white. Fruit much eaten by the natives, and tastes like axle-grease."

No. 2344, from the same locality, is the same in young fruit, which is called "Tutumilla" and is chocolate-colored when ripe. The young fruit is minutely muricate or granular.

CHOMELIA BREVICORNU Rusby, Bull. Torrey Club **52**: 140. 1925. (*No. 1282.*)

CHOMELIA MULTIFLORA Rusby, Bull. Torrey Club **52**: 141. 1925. (*No. 1365.*)

Mapouria (?) rigida

Glabrous, the branchlets rather stout, more or less roughened by the modified lenticels, very leafy. Stipules entire, acutish, about 5 mm. long, thick and rigid, deciduous and leaving a short-fimbricate, brown base. Petioles 5 to 8 mm. long, gradually broadening into the blades, which are 6 to 15 cm. long, 3 to 6 cm. broad, oblong, oval or slightly oblanceolate, with abruptly short-acuminate base and summit, acute or acutish, entire, thickish, rigid, the lower surface pallid, the venation slender, the secondaries about 10 or 12 on each side, widely spreading, then strongly falcate, the venation sparse, loosely anastomosing. Panicle terminal, lax, short and broad, about as long as the peduncle. Bractlets minute, subulate. Pedicels very short, stout, continuous with the short-turbinate calyx-tube, which is about 0.5 mm. long, the abruptly spreading, very short-toothed limb about 1 mm. broad. Corolla thickish, the tube campanulate-cylindraceous, 1 mm. long, slightly 5-angled, the throat campanulate, slightly longer and twice as long as broad, the lobes longer than the throat, ovate, acutish, at length strongly recurved. Stamens attached at the base of the throat, the filaments short and slender, the anthers oblong, stout, extending above the base of the corolla-lobes. Style filiform, the summit thickened, the lobes about half its length, equaling the corolla-lobes, flattened, broadened upward.

Tumapasa, 1,500 feet, *M. Cardenas,* December 9, 1921 (*no. 1968*); also collected by R. S. Williams in the same locality, 1,800 feet, January 22, 1902 (*Williams, 566*).

Mapouria (?) costata

Closely and densely grayish-puberulent throughout, the upper leaf-surfaces minutely so. Branchlets stout, terete. Stipules about 1 cm. long, broadly ovate, obtuse, thickish, minutely ciliate. Leaves sessile or subsessile, 5 to 10 cm. long, 2.5 to 5 cm. broad, oval, obtuse or acutish, rounded to subcordate at the base, entire, thickish, rigid, the midrib and secondaries mostly narrowly grooved on the upper surface, very stout and prominent beneath, the secondaries 12 to 15 on a side, diverging from the midrib, almost at a right angle, the outer portions abruptly upcurved and connecting strongly close to the margin, connected by a stout and close anastomosis. Cymes terminal, shortly peduncled, the peduncle strongly costate, the branches peduncled, densely flowered toward the ends. Calyx campanulate, 1.5 mm. long and broad, very shortly 5-toothed. Corolla-tube campanulate, densely white-pilose within, about as long as the calyx, much shorter than the lobes, which are ovate, the upper two thirds much thickened, and dark-colored, the summits inflexed in the bud. Stamens attached in the sinuses of the corolla. Style short, stout, cleft nearly to the base, the branches thickened upward.

Near Reyes, 1,000 feet, *H. H. Rusby,* October 26, 1921 (*no. 1344*). "A low shrub with white flowers."

Psychotria ramiflora

Inflorescence minutely and sparsely puberulent. Branches elongated and slender, obtusely 4-angled and sulcate. Stipules 5 mm. long and nearly as broad, ovate, obtuse or acutish. Petioles (only the upper seen) 1 to 1.5 cm. long, the margins strongly upcurved. Blades 1 to 1.5 dm. long, 5 to 7 cm. broad, oval, very abruptly and shortly acuminate, obtuse or acutish, the base slightly produced into the petiole, entire, thin, deep green, all the venation slender, lightly prominent on both sides, the midrib finely grooved above, the secondaries 10 or 12 on a side, mostly short-decurrent on the midrib on the upper surface, strongly falcate-ascending, the venation loosely and strongly reticulate. Panicles short or elongated, lax, long-peduncled like the branches and branchlets, the subulate acute spreading or recurved bractlets mostly about equaling the calyx. Flowers mostly two together, sessile or subsessile. Calyx little more than 1 mm. long and broad.

Corolla 6 or 7 mm. long, and half as broad, the lower third of the tube cylindric, only a third as wide as the campanulate upper two thirds, the short triangular-ovate obtuse teeth thickened and inflexed. Stamens attached at the base of the campanulate portion, the filaments very short, the anthers linear, extending to the base of the corolla-teeth, the filaments attached a little above the base. Style about equaling the stamens, somewhat clavate, stout, the branches about a fourth of the total length.

Rurrenabaque, 1,000 feet, *M. Cardenas,* November 26, 1921 (*no. 1852*). Species apparently near *P. luxurians* Rusby.

Psychotria viburnifolia

Pubescent, the upper leaf-surfaces shining. Branchlets weak, crooked, gray-brown, the lenticels much elongate transversely and very narrow. Stipules interpetiolar, single, ovate, 5 mm. long and broad, deciduous, leaving a shortly fimbriate base. Petioles 5 to 8 mm. long, stout, grooved above, the blades 1 to 1.5 dm. long, 3 to 5 cm. broad, thick and rigid, oblong, mostly inequilateral and slightly falcate, acute at both ends, gray-pubescent beneath, especially on the veins, shining above, where the midrib and secondaries are narrowly impressed, these strong and prominent beneath, the secondaries about 6 or 8 on each side, strongly ascending, the venation slender, crooked and coarsely reticulate. Inflorescence short-paniculate or corymbose, the panicles small, long-peduncled, the bracts subulate, acute, very small. Flowers not present. Fruiting pedicels short, thick, strongly angled. Young fruit short-ovoid. Calyx-teeth short, incurved, subulate.

Rurrenabaque, 1,000 feet, *M. Cardenas,* December 1, 1921 (*no. 1891*).

FARAMEA

This genus, which is very abundant in the Bolivian Andes, has come to be abundantly represented in herbaria, especially in that of The New York Botanical Garden. One or more of the collections made by the author in 1886 and 1887 were referred by Dr. Britton to *F. salicifolia* Presl, which, in the flowering state, they very closely resembled. Later collections, made by M. Bang and others, very closely resembled the former. Not being well enough acquainted with the genus to know its tendency to variation within the species, *F. salicifolia* was regarded as a variable species, with many varieties or forms. A careful study of the material that has now accumulated under this name shows clearly that this view was erroneous, and that we have a group of species closely resembling one another, not one of them apparently representing the species to which they have been referred. *F. salicifolia* is a species of southern Brazil, and probably does not occur in Bolivia, being distinguished from all Bolivian species that I have seen by its strongly muricate fruit. The following species are proposed:

Faramea benensis

Glabrous. Branches obscurely quadrangular, the leaves divaricate. Stipules coherent into a ribbed cylinder 2 or 3 mm. long, bearing four setae nearly as long as the sheath. Petioles 5 to 8 mm. long, margined, the margins more or less incurved. Blades to 15 cm. long and 6 cm. broad, lanceolate, with the abrupt base slightly produced into the petiole and the summit acuminate and acute; entire, thin but rigid, bright-green, the midrib lightly prominent on both sides, the slender secondaries 8 or 10 on each side, diverging at a right angle but the outer portions strongly falcate-ascending and looped together at some distance from the margin, the venation inconspicuous. Cymes terminating the upper branchlets, compound, loosely flowered, peduncled, the peduncles or their branches angled. Pedicels 5 to 8 mm. long, slender, sharply angled. Calyx-tube 0.5 mm. long, cupulate, the limb rotate, about twice as broad as the tube, lightly 4-lobed. Corolla-tube 6 mm. long, the lower half narrower and its middle portion somewhat contracted, the lobes 4, half as long as the tube, of thick texture, oblanceolate, obtuse, the summit apparently bearing a black gland upon the inner face. Anthers reaching the base of the corolla-lobes, half as long as the tube, oblong, attached just above the base to a very slender short filament. Style filiform, longer than the corolla-tube, the style-branches short, slightly enlarged at the summit, obtuse. Epigynous disk large, tumid, blackish.

Rurrenabaque, 1,000 feet, *M. Cardenas,* November 24, 1921, (*no. 1773*). Fruiting specimens collected by the author in May, 1886, in Mapiri, 2,500 feet, Parke, Davis & Co. (*no. 2620*), and by M. Bang, in December, 1892, between Tipuani and Guanai (*no. 1684*), apparently belong to this species. The mature fruits are on spreading pedicels, 5 to 7 mm. long, and are 1.5 cm. broad, 8 mm. long and nearly as thick, transversely elliptical, dark-green and glabrous.

Faramea tenuifolia

(Fruiting specimen.) Glabrous. Branchlets elongate, slender, nerved, or the younger narrowly angled. Stipules connate, broader than long, papillose, aristate, the awns elongating, at length 4 or 5 mm. long. Petioles divaricate, 1 cm. long, including the abruptly produced base of the leaf, margined. Blades to 1 or even 1.5 dm. long, and 5 cm. broad, oblong or oval, with the base abruptly contracted into the petiole and an abruptly short-pointed and obtuse summit, thin. Cymes terminating the branchlets, slenderly peduncled, mostly simple and small, with mostly about 5 fruits. Pedicels very slender, 4 or 5 mm. long. Mature fruits about 6 mm. broad and 5 mm. high, bearing the shortly toothed calyx-limb, which is about 1.5 mm. broad, and surrounds the concave style base, the surface of the fruit being densley papillose or muricate. This is the only Bolivian species with muricate fruit that I have seen, but it is evidently quite distinct from *F. salicifolia.*

Rurrenabaque, 1,000 feet, *M. Cardenas,* January 21, 1922 (*no. 2048*).

Diodia rogaguana

Gray-hispid, with short divergent hairs, the stems elongate, stout, quadrangular. Stipules very unequal, filiform, rigid, pilose. Leaves sessile, 1.5 to 2.5 cm. long, 5 to 12 mm. broad, lanceolate to oblanceolate, obtuse or acutish, thickish, 5- to 7-ribbed, the ribs consisting of stout, rough-hairy secondaries, which are impressed above, very prominent beneath. Axillary whorls several- to many-flowered, the flowers closely sessile. Calyx-tube hemispheric, in flower shorter, in fruit longer than the four linear, thick, obtuse erect lobes. Corolla about as long as the calyx, the tube campanulate. Stamens exserted, incurved, the anthers short. Style exserted, bifid, the branches somewhat unequal. Fruit 2.5 mm. long and nearly as broad.

On the pampas near Lake Rogagua, 1,000 feet, *H. H. Rusby,* October, 1921 (*no. 1723 A*).

Borreria (?) nectarifera

Leaves, etc., scabrous, the internodes nearly glabrous. Stems occasionally nearly a meter high, slender, simple or little branched, the branches erect. Internodes mostly longer than their leaves, quadrangular, the angles slightly winged. Stipular setae filiform, rigid, unequal, those nearest the leaves reaching 8 mm. in length. Leaves sessile, to 3 cm. long, linear-lanceolate, acuminate at both ends, obtusish, entire, margin strongly revolute, thick and rigid, the midrib very stout and prominent beneath. Cymes verticillate, very dense and many-flowered. Calyx-tube narrowly turbinate, the limb 4-parted, with several small intermediate teeth, lobes somewhat unequal, to 2 mm. long and a little longer than the tube, in fruit, lance-linear or subulate, rigid, whitish with a broad green midrib, obtusish. Corolla 3 mm. long, 4-parted nearly to the base, the lobes oblong, obtuse, white, bearing a brown gland in the center, above the middle. Anthers nearly sessile, in the sinuses, oblong, nearly 1 mm. long, oblong. One of the mericarps tardily dehiscent on the inner face.

On the pampas near Lake Rogagua, 1,000 feet, *H. H. Rusby,* November 4, 1921 (*no. 1659*). "Growing in water."

It would appear that a plant with a petaloid appendage of this kind should be generically distinct from *Borreria,* but all its other characters are in such close agreement with this genus that I scarcely feel disposed to separate it.

Mitracarpum simplex

Sparsely pubescent with short, white, mostly divergent hairs, the leaves somewhat strigose. Stems slender, obscurely quadrangular, more so above than below. Leaves sessile, 2 to 3.5 cm. long, 5 to 10 mm. wide, oblanceolate, acute or acutish, thin, light-green, the midrib and secondaries slender, the latter about 3 on each side, suberect. Cymes small, dense. Bracts coherent, about 3 mm. long, lacerate, the teeth acuminate and very acute. Bractlets setose, slender, acute, unequal, the largest to 3 mm. long. Flowers not dissected. Fruits shortly pedicelled, circumscissile at the middle or slightly lower, the calyx-tube short and broad, about as long as the teeth, which are very unequal, subulate, acuminate and acute, rigid, dark-green.

A single specimen collected in Bolivia on the Mulford Exploration, without locality or date (*no. 1993 A*).

CUCURBITACEAE

Gurania plumosa

(Staminate plant.) Pilose throughout with long soft white hairs. Stems elongate, slender, green, deeply sulcate. Petioles about a fourth the length of the blades, their white shining hairs divaricate, like those of the stem, peduncles, etc. Blades varying from 20 cm. long and 14 cm. broad to 16 cm. long by 15 cm. wide, cordate with rounded sinus and lobes, the base slightly produced into the sinus. Broader leaves tending to be slightly 3-lobed, the others ovate, the summit abruptly contracted into a finely attenuate point 2 or 3 cm. long. Margin strongly ciliate and armed with scattered teeth which are reduced to very small divaricate points. Upper surface deep-green, rather sparsely clothed with the hairs described above, the lower surface gray-green, more densely clothed in the same way. Leaves 3- to 5-ribbed, the ribs lightly prominent, slightly keeled or 1- to 3-nerved, the remaining venation loose and weak. Peduncle slender, its length not determined, bearing a swollen point or articulation below the flowers, which are densely capitate, the calyx beautifully clothed throughout with very long, white, and shining divaricate hairs. Calyx-tube 6 mm. long, nearly 4 mm. broad, the teeth somewhat unequal, to 3 cm. long, of setaceous form. Petals less than half the length of the calyx-teeth, thick and rigid, somewhat recurved, somewhat united at the base. Stamens 5 mm. long, the anthers 3 mm. long, white, oblong.

Tumapasa, 1,000–1,500 feet, *O. E. White,* December 6, 1921 (*no. 1827*). "A vine, 15 to 20 feet long, on a tall tree in damp shady sandy loam. Calyx scarlet-orange, the corolla yellow. Juice not milky." Species very near *G. Andreana* Cogn.

Gurania annulata

(Pistillate plant.) Finely and closely tomentellate. Stems elongate, slender, sulcate, reddish, sparsely puberulent. Petioles somewhat shorter than the leaves, flattened, costate, twisted, dilated at the base, strongly channeled by the upturned margins. Blades 1.5 dm. long and a little broader, broadly cordate, 3-lobed. Base of blade triangular, a little wider than long, meeting the petiole slightly higher than the bases of the broadly rounded basal lobes, strongly margined by the thick lateral ribs, the sinuses between it and the basal lobes broad and rounded, one more so than the other. Middle lobe of leaf about three fifths the length of the blade, its width a little more than half its length, somewhat narrowed at the base, abruptly short-acuminate and acute, sinuate-dentate, the sharp salient teeth much smaller than those of the outer leaf-margin. Lateral lobes inequilaterally ovate, broadest at the base, acute, the sinuses narrow, obtuse. Outer margin of leaf irregularly erose-dentate, the teeth broadly triangular, acute, divaricate. Upper leaf-surface green, minutely strigulose and slightly harsh, the venation not prominent, the lower surface gray-green, softly tomentellate, the venation lightly prominent, strongly, crookedly and coarsely anastomosing. Umbels sessile along and at the end of leafless branches. Bracts of the gray-tomentellate umbel unequal, elongate-subulate with attenuate summit. Pedicels elongating somewhat in fruiting, more or less flattened, scarlet, at least above, almost imperceptibly continuing into the base of the calyx and ovary. Calyx-tube, in the young flowering stage, 2 cm. long to the summit of the ovary, the throat above that portion 1 cm. long to the base of the lobes, the base of the throat bearing an annulus that is incurved over the summit of the ovary. Calyx-teeth somewhat unequal, to about 1 cm. long, subulate, attenuate and acute. Petals about half the length of the calyx-lobes, ovate, acute, thick. Young fruits oblong, about 3 times as long as broad, puberulent, bearing the flower, with its enlarged peculiar annulus.

Near Reyes, 1,000 feet, *M. Cardenas*, November 12, 1921 (*no. 1733*). "Climbing in copses of pampa."

Gurania latifolia

(Staminate plant.) Nearly glabrous. Stems elongated, very slender, very minutely and sparsely puberulent. Petiole about one third the length of the blade, green, flattened, dilated at the base, 3-ribbed on the upper surface. Blade shallowly and very broadly cordate, deeply 3-lobed, its length about four fifths of its breadth. Basal lobes very short and broad, rounded, the base of the blade slightly produced into the sinus, shortly and broadly triangular, margined by the lateral ribs. Middle lobe ovate-oval, half as wide as its length, the base contracted to about half-width, the summit very abruptly contracted into a very short acute point, the margin sinuate-dentate, the teeth nearly obsolete. Sinuses open but not wide, obtuse. Lateral lobes inequilaterally ovate, with summit and margin the same as those of the middle lobe. Leaf thin, green above and almost imperceptibly strigulose, pale or gray-green underneath, slightly papillose-roughened, the slender venation slightly prominent. Tendrils green, flattened, the margins thickened. Peduncles rather short (7 to 10 cm. in my specimen), divaricate, ribbed, a concave brown gland near the base. Flowers densely racemose, the scars, after their fall, enlarging into light-brown nodose bodies. Bracts 5 to 8 mm. long, ovate, acute. Flowers 1 to 1.5 cm. long, according to their age, the tube twice the length of the limb, ventricose, contracted at the summit. Calyx-lobes ovate, acuminate and acute, erect or slightly spreading, 2 of them a little larger than the others. Petals shorter than the calyx-lobes. Filaments very short, the anthers about equaling the petals, narrow, acuminate with a short white flattened obtuse terminal appendage.

Above Cochabamba River junction, near Covendo, 2,000 feet, *O. E. White,* August 26, 1921 (*no. 917*). "A vine, 10 to 20 feet long, with milky juice, in deep damp shady woods, in sandy loam. Flowers orange-colored."

There is a possibility that this is the male plant of *G. annulata,* although the characters of bracts, calyx-lobes, and especially of the inflorescence, lead to a different conclusion.

CARDUACEAE

ERIGERON SENECIIFORMIS Blake, Proc. Biol. Soc. Wash. **36**: 51. (*No. 1206.*)

ASPILIA LUCIDULA Blake, Proc. Biol. Soc. Wash. **36**: 52. 1923. (*No. 758.*)

CALEA RHOMBIFOLIA Blake, Proc. Biol. Soc. Wash. **36**: 53. 1923. (*No. 2164.*)

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THE FLORA OF THE SAINT EUGENE SILTS, KOOTENAY VALLEY, BRITISH COLUMBIA

ARTHUR HOLLICK

(WITH PLATES 29–47 AND ONE TEXT-FIGURE)

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Introduction

Several years ago I received from the Geological Survey of Canada a number of specimens of fossil plant remains that had been found in deposits designated as the Saint Eugene silts, which are exposed in the Kootenay Valley, on the Saint Mary River, in the vicinity of Saint Eugene Mission, British Columbia. These silts, according to information furnished me at that time, were regarded as Pleistocene and Interglacial in age, by geologists who were acquainted with their stratigraphic relations. The specimens were examined, and a preliminary report was transmitted to the Director of the Survey, which was included in the Summary Report of the Survey for the year 1913.[1]

The report included about a dozen generic identifications (*Hicoria, Fagus, Ficus, Cebatha, Platanus,* etc.) but no specific descriptions. The specimens were, however, tentatively compared with existing species, and the conclusion was expressed (*loc. cit.,* p. 135) that "an analysis of these identifications indicates that at least a warm-temperate climate must have prevailed in the Kootenay Valley at the time when this flora was living there. The presence of the genus *Ficus* alone is sufficient evidence on this point. . . . The other genera are so widely distributed, north and south, that, regarded by themselves they would have but little significance as climatic indices. The prevailingly large size of the leaves, however, indicates a luxuriant growth such as would probably obtain only in a climate milder than that of the middle United States. . . ."

Subsequently certain specimens that were identified as representing the genus *Ficus,* consisting of well-defined fruiting branches, were critically studied and were described under the name *Ficus interglacialis*;[2] and a further analysis of the flora and its apparent contemporaneous climate resulted in the expressed opinion (*loc. cit.,* pp. 45, 46) that the specimens "all apparently represent undescribed species and they are large in size as compared with the Pleistocene leaves from the Don Valley in Ontario. . . . The two floras are quite distinct, but no correlation has yet been made between the two series of deposits.''

---

[1] A preliminary report by Mr. Arthur Hollick [misprinted Hollock] of the New York Botanical Garden, upon the plants from the Pleistocene deposits. Summary Rept. Geol. Survey [Canada], Dept. Mines, for the calendar year 1913 (Sessional Paper No. 26, 4 George V, 1914), pp. 133–135. Ottawa, 1914.

[2] Hollick, Arthur. A new fossil species of Ficus and its climatic significance. New York Bot. Gard., Jour. vol. 16, pp. 43–47, pls. 152, 153. Mr. 1915.

Subsequently, in order, if possible, to obtain the most recent expression of opinion in regard to the age or stratigraphic relations of the Saint Eugene silts, I wrote to Dr. E. M. Kindle, Chief of the Division of Paleontology of the Survey, who responded under date of October 26, 1925, and transmitted a memorandum, of which the following is a copy:

Memorandum
to
Dr. E. M. Kindle,
Dept. of Mines, Ottawa.

Mr. [W. A.] Johnston has referred to me your correspondence with Dr. Hollick regarding the flora from the St. Eugene silts near Cranbrook, B. C.

I assisted Dr. [S. J.] Schofield in making, during the season of 1921, a collection from the St. Eugene silts. He makes no note of this section in his 1921 notes. I remember the section distinctly and give it below:

Erosional surface.
Glacial till.
Silt.
Glacial till.
Silt, sandy silt and partially consolidated sandstone containing plant remains at several horizons.
Partially consolidated conglomerate.
Base unexposed.

Dr. Schofield[3] . . . apparently places the uppermost till in the Wycliffe glacial epoch, and the remainder of the section in the St. Eugene interglacial (?) epoch. You will note that no glacial material is exposed below the horizon containing the plant remains. The beds containing the plant remains are practically undisturbed, having but a very slight dip to the east (general direction). The sediments were, clearly, deposited in standing water and are evenly and finely bedded. The conglomerate below the fossiliferous beds is made up of worn and sorted cobbles and cemented to a large extent with iron.

---

[3] Schofield, S. J. Geology of the Cranbrook map-area, British Columbia. Canada Dept. Mines, Geol. Survey, Mem. 76 (No. 62, Geol. Series). 1915.

There is no field evidence to show the interglacial age of the plant-bearing beds. I may say that I have found no fossils in the glacial deposits along the Rocky Mountain trench in the region from Cranbrook to Golden. The glacial silts were apparently deposited by lateral, glacial streams emptying into a lake occupying the trench, upon the retreat of the ice. It does not seem probable that climatic conditions would have been favorable for a warm climate flora to flourish in isolated areas in the trench when glacial action was undoubtedly very active in the bordering mountains.

I trust this information will help to clear up the age of the beds under discussion.

[signed] JOHN F. WALKER.

In his communication, transmitting the above memorandum, Doctor Kindle remarked: "Mr. Johnston has the impression that the plant-bearing beds are of late Tertiary age. However that may be, the memorandum by Walker at least indicates their relationship to the only glacial deposits which have actually been seen in the area where the plants are found, and suggests that the base of the Pleistocene and the top of the St. Eugene silts should be drawn at the bottom of division F (see p. 393) of Schofield's section."

In order that the above stratigraphic references may be more clearly understood I have thought it advisable to quote from Doctor Schofield's Memoir (*op. cit.*, pp. 85–87, 90–91) certain paragraphs descriptive of the geology, as follows:

> "The greater part of the Cranbrook map-area is covered with drift, especially the Rocky Mountain trench and the valley of Gold Creek. From their character and distribution, the records are interpreted as belonging to two glacial periods separated by a period of glacial retreat. The interglacial deposits are remarkable for their content of a flora whose modern representatives are indigenous to a climate warmer than that of the southern United States. The deposits, Pleistocene and Recent, can be subdivided as follows:

Recent	*Post Glacial epoch.*
	Valley alluvium.
	Delta deposits.
Pleistocene	*Wycliffe Glacial epoch.*
	Stage of glacial retreat.
	Marysville sands.
	Stage of glacial occupation.
	Wycliffe drift.
	St. Eugene interglacial (?) epoch.
	St. Eugene silts.

"The Pleistocene deposits in the neighborhood of the Rocky Mountain trench (Kootenay River valley) can be classified under two main heads, viz: the Wycliffe drift, named after the town of Wycliffe on the branch line of the Canadian Pacific Railway from Cranbrook to Kimberly, and the St. Eugene silts named after the St. Eugene Mission. A detailed section, measured on the east bank of the St. Mary River about 3 miles east of Wycliffe, gave the following results:

		Erosion surface			
Recent	A.	Stratified sand	15	feet.	Marysville sands.
		Unconformity			
Pleistocene	B.	Till	30	"	Wycliffe drift.
	C.	Stratified silt	25	"	St. Eugene silts.
	D.	" gravel	15	"	
	E.	" silt	5	"	
	F.	Unstratified coarse gravel (till?)	25	"	
	G.	Stratified sandy clay (fossil plants)	60	"	
	H.	Stratified gravels, lignite (base unexposed)	60	" "	

"Member G consists mainly of finely stratified silts and clay, with some gravel. The more clayey members near the base contain, between the laminae, numerous well-preserved plant remains of the Pleistocene. . . .

"The St. Eugene silts occur over a large area in the Rocky Mountain trench and are exposed along the cut banks of the Kootenay River at an elevation of about 2,800 feet. In the determination of the age of these silts the following facts are known:

1. The silts are horizontal.
2. They underlie unconformably a till sheet.
3. As far as known they are not underlain by a till sheet.
4. They are well stratified and were deposited in quiet waters.
5. They contain abundant plant-remains of the Pleistocene.

"From these facts the silts may be: (1) pre-Glacial, and post-Tertiary; (2) interglacial, the underlying till sheet having been eroded away.

"The age of these silts must at this stage remain an open question, as the only fact which would prevent the silts from being post-Tertiary and pre-Glacial would be the presence of a till sheet older than the silts.

"In composition and thickness these silts are similar to those described by Dawson [Geol. Surv. Canada, Ann. Rept. 1894, p. 251 B] and Drysdale [*idem,* Summary Rept. 1912, p. 150] who found them near Ashcroft, underlain by an older boulder clay. If this correlation be correct, the St. Eugene silts are interglacial."

From the foregoing it may be appreciated that the exact geologic age of the silts in which the plant remains are included is, apparently, an open question, as far as the results of field observations and studies are concerned, and that the correct determination of the floral elements, and any conclusions or inferences which may be deduced from them, may be important factors in assisting to solve the problem of the age of the silts.

Descriptions of specimens

SPERMATOPHYTA

Angiospermae

Monocotyledonae

Monocotyledon (leaf ?) gen. et sp.?

Plate 29, figure 1

"Fragments of a large leaf, with obscure parallel nervation." Hollick, Summary Rept. (*loc. cit.*), p. 133.

This specimen is too fragmentary, and with characters too obscurely defined, to admit of anything more than provisional identification as the median portion of a large monocotyledonous leaf, with parallel nervation. The margin is broken and irregular and shows obscure indications of filamentous or spiny processes, somewhat suggestive of "Spanish bayonet" (*Yucca*), or a species of fan palm, such as is represented in the genus *Neowashingtonia*; but apparently the leaf tissue was thinner than is characteristic of these genera.

Monocotyledon (culm or petiole?) gen. et sp.?

Plate 29, figure 2

"Fragment of a stem, with well-defined longitudinal striation." Hollick, Summary Rept. (*loc. cit.*), p. 133.

This specimen apparently represents some hard part of a monocotyledonous plant. Longitudinal striations are fine and well defined. There are no indications of nodes or ligular attachments, such as might be expected to be present if the specimen was part of the culm of a sedge or grass, although it might represent an internodal portion. Its general appearance is more suggestive of a piece of the petiole of a palm leaf. Whether or not it had anything in common with the monocotyledonous leaf fragment last described is impossible to determine, or even to surmise. The two specimens are of interest merely as representing the class of vegetation to which they apparently belong.

Dicotyledonae

(CHORIPETALAE)

Order JUGLANDALES

Family JUGLANDACEAE

Genus *Hicoria* Rafinesque

Hicoria pseudovata n. sp.

PLATE 30, FIGURES 1, 2

"*Hicoria* n. sp.?" Hollick, Summary Rept. (*loc. cit.*), p. 134.

Leaflets oblong-elliptical or oblong-lanceolate-ovate in shape, about 11 centimeters in length by 5 centimeters in maximum width, tapering to base and apex; margin closely and uniformly denticulate; nervation simply pinnate; secondary nerves irregularly spaced and disposed, subtending various angles, of about 45° and less, with the midrib, curved upward toward their extremities, where they give off fine nervilles in the form of branches from the under sides, that terminate in the adjacent marginal denticulations.

These specimens apparently represent sessile leaflets of a compound leaf closely similar to those of certain existing species of hickory, especially *Hicoria glabra* (Miller) Britton, and *H. ovata* (Miller) Britton. FIGURE 1 apparently represents two fragmentary, overlapping lateral leaflets, attached to a broken leaf stalk. These present somewhat the appearance of being confluent at their bases, but this appearance is probably due to distortion and overlapping. FIGURE 2 represents a single detached lateral leaflet.

Remains of leaves and nuts of hickories are abundantly represented in American Pleistocene deposits. Leaves referred to *Hicoria ovata,* under the name *Carya alba* Nuttall, from the interglacial deposits of the Don Valley, near Toronto, Canada, were recorded by Penhallow,[4] but without any illustration. The same species, represented by two incomplete terminal leaflets, was also recorded by Berry,[5] but not figured, in a list of Pleistocene plant remains, from deposits on the Neuse River, North Carolina. In a subsequent paper the same author[6] described and figured specimens of leaflets from the Pleistocene of the same State, some of which he referred to *Hicoria glabra* (*op. cit.,* p. 106, pl. 46, figs. 1–4), and some to *H. ovata* (*idem,* figs. 6, 7). Those referred to *H. glabra* may be seen to compare quite closely with ours, both in size and general appearance. He also cites *Hicoria pseudoglabra* Hollick,[7] from the Pleistocene of Maryland, as a synonym of *H. glabra.* In no instance, however, has a complete leaflet been preserved, and adequate or satisfactory comparison is impossible, either in connection with the fragmentary fossil remains or between them and leaves of existing species. Nuts and husks of *Hicoria ovata,* and of *Hicoria glabra,* were also listed by Berry[8] from Pleistocene deposits in Virginia, Maryland, and New Jersey; and similar remains, described and figured by Mercer,[9] are abundantly represented in deposits of approximately equivalent age, in the so-called "bone caves" of Tennessee and Pennsylvania. It is evident that species of hickory, closely allied to or specifically identical with the existing pignut and shell-bark, were prominent elements in the Pleistocene flora of North America.

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[4] Penhallow, D. P., in Dawson, Penhallow and others. Canadian Pleistocene flora and fauna. British Assoc. Adv. Sci., Rept. Bristol meeting, p. 528. 1898.

[5] Berry, E. W. Contributions to the Pleistocene flora of North Carolina. Jour. Geology vol. 15, p. 340. 1907.

[6] Berry, E. W. Pleistocene plants from North Carolina. U. S. Geol. Survey, Prof. Paper 140–C. 1926.

[7] Hollick, Arthur. Md. Geol. Survey, Pleistocene, p. 221, pl. 72, figs. 1, 16, 17. 1906.

[8] Berry, E. W. Pleistocene plants from North Carolina (*op. cit.*).

Pleistocene plants from Virginia Torreya, vol. 6, p. 89. 1906.

Juglandaceae from the Pleistocene of Maryland. *Idem,* vol. 9, p. 97, figs. 1–5. 1909.

Additions to the Pleistocene flora of New Jersey. *Idem,* vol. 10, p. 264, fig. 1. 1910.

[9] Mercer, H. C. The finding of the remains of the fossil sloth at Big Bone Cave, Tennessee, in 1896. Amer. Philos. Soc., Proc. vol. 36, no. 154, pp. 58, 60–62, 66, figs. 15 (4, 5), 17 (7, 9), 18 (in part), 19 (in part), 25 (1, 2). Jan. 15, 1897.

The bone cave at Port Kennedy, Pennsylvania, and its partial excavation in 1894, 1895 and 1896. Acad. Nat. Sci. Philadelphia, Jour. ser. 2, vol. 11, pp. 277–278, 279, figs. 8 (4), 8 (5), 8 (6), 8 (12), 8 (16). Ap. 24, 1899.

Order FAGALES

Family BETULACEAE

Genus *Betula* Linnaeus

Betula ulmoides n. sp.

PLATE 31, FIGURE 1; PLATE 32, FIGURE 1

"*Ulmus* n. sp.?" Hollick, Summary Rept. (*loc. cit.*), p. 134.

Specimens represented by basal parts of leaves that resemble those of certain of our existing birches, such as the rounded or cordate forms of *Betula cordifolia* Regel, *B. lenta* Linnaeus, *B. lutea* Michaux f., etc.

The leaves vary in size, with rounded-truncate or subcordate, and somewhat oblique or unsymmetrical bases suggestive of the genus *Ulmus,* and finely dentate margins.

A fragment originally identified as an *Ulmus* (*loc. cit.*) is represented by FIGURE 1, on PLATE 31; but it appears to be more satisfactorily comparable with the genus *Betula,* and I have ventured to include it in that genus together with the smaller specimen represented by FIGURE 1, on PLATE 32. Satisfactory comparisons, or adequate specific description is impossible, in the absence of any knowledge in regard to the shape and the marginal characters of the upper part of the leaves. For purposes of comparison, however, I have introduced (PLATE 44, FIGURE 1) a figure of a typical average leaf of *Betula lenta,* the base of which is closely similar to the basilar parts of our specimens. Many individual leaves of *B. lutea,* however, with more conspicuously oblique bases, might also be selected for comparison, and it would be difficult to decide to which of these two species our specimens appear to bear the closest resemblance.

Betula lutea was listed from the Ottawa valley by Penhallow,[10] in a report on the Pleistocene flora of the Don Valley, Canada, but without any description or illustration.

Genus *Alnus* Hill

ALNUS sp.

PLATE 31, FIGURE 2

"*Alnus* n. sp.?" Hollick, Summary Rept. (*loc. cit.*), p. 134.

This fragmentary specimen represents a piece of the upper portion of a leaf that is suggestive of the obovate forms of several existing American species of alder, such as *Alnus serrulata* Willdenow, *A. fruticosa* Ruprecht, and *A. oblongifolia* Torrey, and the Old World species *A. rotundifolia* Miller (=*A. glutinosa* Miller)—especially the last, which is a common element in the European Pleistocene flora. This was also described by Reid,[11] based upon identification of seeds, from deposits regarded as Pliocene in age, and by Marty,[12] based upon folial identifications, from deposits regarded as of Miocene age. In particular our specimen may be compared with the similar large fragmentary one represented by Marty's figure 2, plate 3 (*op. cit.*); and except for its much larger size it is suggestive of specimens from the Pleistocene (Talbot formation) of Maryland, described and figured by the writer[13] and referred to the existing eastern North American species *Alnus rugosa* K. Koch (=*A. serrulata* Willdenow). Our specimen, in its entirety, was apparently obovate in shape, with a somewhat uneven or wavy margin, finely dentate, the dentitions consisting of an obscurely defined major series with minor denticulations between. Its fragmentary condition renders impossible either a specific description or a positive identification that would be of any value.

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[10] Penhallow, D. P., in Dawson, Penhallow and others. Canadian Pleistocene flora and fauna. British Assoc. Adv. Sci., Rept. Sec. C., Bradford meeting, pp. 335, 338. 1900.

[11] Reid, Eleanor M. Two pre-glacial floras from Castle Eden. Geol. Soc. [London], Quart. Jour. vol. 76, pt. 2, p. 118, pl. 8, fig. 1. 1920.

[12] Marty, Pierre. Flore Miocene de Joursac (Cantal), p. 27, pl. 2, fig. 11; pl. 3, figs. 1, 2. 1908.

[13] Hollick, Arthur. Md. Geol. Survey, Pliocene and Pleistocene, p. 225, pl. 69, figs. 1–3. 1906.

Incidentally, it is of interest to note, in connection with the several species above mentioned, that the general type of alder leaf that they represent has an ancestry that began as far back as the Miocene in the Old World, and in America also according to Newberry,[14] who described and figured a leaf from the Miocene of Bridge Creek, Oregon, under the name *Alnus serrulata fossilis* (*op. cit.*, p. 66, pl. 46, fig. 6), and remarked: "Among the leaves . . . occurs one . . . which . . . it will be seen at a glance . . . closely resembles the leaves of *A. serrulata,* and I have been unable to find any characters upon which to base a distinction. More material will, of course, be needed before the fact may be considered established that our most common alder was growing in the Tertiary. There would be nothing surprising, however, in such a discovery; indeed it was to be expected that this species, so wide-spread as it now is, should have some representative in the Tertiary flora."

From the above references and citations it may be inferred that any fossil alder leaf of the general type represented by those of the several existing species discussed would not be of much value in critical stratigraphic investigations, and any statement that might express or imply definite identification with any existing species might lead to erroneous conclusions in regard to areal as well as vertical distribution.

A species of alder ("*Alnus* sp.") was also listed by Penhallow (*loc. cit.,* 1900, pp. 335 and 338), from the Canadian Pleistocene of the Don River Valley, but without any description or illustration.

Family FAGACEAE

Genus *Fagus* Linnaeus

Fagus sanctieugeniensis n. sp.

PLATE 30, FIGURE 3; PLATE 31, FIGURE 3; PLATE 32, FIGURES 2, 3

"*Fagus* n. sp." Hollick, Summary Rept. (*loc. cit.*), p. 134.

Leaves ellipsoidal to obovoid in shape, varying in size from about 12 to 18 centimeters in length by from 5 to 8 centimeters in maximum width; margins varying from triangular-wavy to serrate-dentate; nervation simply pinnate; secondary nerves mostly alternate, occasionally opposite, the upper ones straight or slightly curved upward toward their extremities, the lower ones mostly curved slightly downward or backward toward their extremities, each secondary terminating in one of the marginal dentitions.

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[14] Newberry, J. S. The later extinct floras of North America. U. S. Geol. Survey, Mon., vol. 35. 1898.

These leaves are very similar in general appearance to those of the existing North American beech, *Fagus grandifolia* Ehrhart, although our specimens are larger in size than the average of the leaves of the species mentioned, a typical, rather large leaf of which, collected in The New York Botanical Garden, is represented by FIGURE 2, PLATE 44.

Fagus grandifolia (=*F. ferruginea* Aiton and *F. americana* Sweet), mostly represented by nuts and husks,[15] has been identified in many of the American collections of Pleistocene plants; and well-preserved specimens of leaves, as well as a husk, were described and figured by Berry[16] from the Pleistocene of North Carolina, under the synonym *Fagus americana.* These leaves, as figured, show a close resemblance to our specimens, and also to a fragmentary specimen from the Pleistocene of Maryland depicted by the writer[17] and described as "*Fagus* sp.?"

Whether or not these specimens, as well as ours, should all be referred to the existing species may best be regarded merely as a matter of individual opinion.

It may, however, be pertinent here to call attention to the fact that almost equally satisfactory comparisons may be made with certain Tertiary species, such as *Fagus deucalionis* Unger[18] of the Old World; *F. Antipofii* Abich and *M. macrophylla* Unger, as depicted by Heer[19] from the Miocene of Alaska, and by Lesquereux[20] from the Miocene of California; and *F. sylvatica fossilis* Laurent and Marty,[21] from the Pliocene of the Netherlands, etc.

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[15] (a), Berry, E. W. Pleistocene plants from Virginia. Torreya, vol. 6, p. 88. 1906. Contributions to the Pleistocene flora of North Carolina. Jour. Geology, vol. 15, p. 341. 1907.

(b), Meehan, Thos., in Mercer, H. C. The bone cave at Port Kennedy, Pennsylvania, and its partial excavation in 1894, 1895, and 1896. Acad. Nat. Sci. Philadelphia, Jour. vol. 11, pt. 2, p. 279, fig. 8 (15). Ap. 24, 1899.

[16] Berry, E. W. Pleistocene plants from North Carolina. U. S. Geol. Survey, Prof. Paper 140–C, p. 108, pl. 48, figs. 3–13. 1926.

[17] Hollick, Arthur. Md. Geol. Survey, Pliocene and Pleistocene, p. 226, pl. 70, fig. 3. 1906.

[18] Unger, Franz. Chloris protogaea, p. 101, pl. 27, figs. 5, 6. 1847.

[19] Heer, Oswald. Flora fossilis arctica, vol. 2, pt. 2 (Fossile flora von Alaska), pl. 7, figs. 4–6, 8. 1869 (=*F. Antipofii*). *Idem*, pl. 8, fig. 2 (=*F. macrophylla*).

In general it may be said that the specimens from the Saint Eugene silts are most nearly comparable in size with leaves of *Fagus* of recognized Miocene and Pliocene age, and that in other surficial features they are closely similar to the existing *F. grandifolia.* Satisfactory differentiation of the several species, fossil and living, one from another, is often difficult to accomplish and must, in many instances, be regarded as merely a matter of individual and personal opinion. As an index fossil, in connection with critical stratigraphic work, it is evident that any fossil leaf of this general type would be of as little value as the leaves of *Alnus* discussed in the preceding pages.

In our existing flora the only species native to North America is *F. grandifolia,* and this species does not now extend further north than southern Ontario or further west than Wisconsin.

FAGUS sp.

PLATE 30, FIGURE 4

"*Fagus* n. sp.?" Hollick, Summary Rept. (*loc. cit.*), p. 134.

Leaf apparently about 6 to 7 centimeters in length by about 4 to 4.5 centimeters in maximum width; margin dentate; nervation simply pinnate; lower secondary nerves curved and more or less reflexed or bent downward toward their extremities.

This specimen is too fragmentary for accurate or satisfactory comparison; but there can be hardly any question that it represents a species of beech, and it is possible that it may be only a small form of the species last described. The size of the leaf, in its entirety, was apparently about equal to that of the average of leaves on a tree of our existing *Fagus grandifolia* Ehrhart, or of the Old World *F. sylvatica* Linnaeus. In view of the fragmentary nature of the specimen, however, any further discussion or suggestion in regard to its apparent specific relationships would not seem to be of any value.

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[20] Lesquereux, Leo. Mus. Comp. Zoöl. Harvard Coll., Mem. vol. 6, No. 2 (Report on the fossil plants of the auriferous gravel deposits of the Sierra Nevada), pl. 2, fig. 13. 1898 (= *F. Antipofii*).

[21] Laurent, Louis, & Marty, Pierre. Flore foliaire Pliocène des argiles de Reuver. Rijks Geol. Dienst [Holland], Mededeel., ser. B, no. 1, p. 35, pl. 11, figs. 1–7. 1923.

Genus *Quercus* Linnaeus

Quercus kootenayensis n. sp.

PLATE 32, FIGURE 4

Leaf somewhat bent or curved to one side, about 8 centimeters in length by 6 centimeters in maximum width, apparently oblong-ovate in shape, with a rounded-truncate base; margin wavy or broadly crenate-dentate; midrib relatively slender, and curved in conformity with the curvature of the leaf; nervation simply pinnate; secondary nerves irregularly disposed, subparallel, each terminating in one of the marginal dentitions, those on the convex side of the leaf subtending angles of about 45° with the midrib, those on the concave side subtending angles somewhat more obtuse.

I have not been able to match this leaf satisfactorily with leaves of any existing or fossil species of oak, although its reference to the genus *Quercus* appears to be correct. In connection with its marginal characters it is suggestive of the existing eastern North American species *Quercus Prinus* Linnaeus; but leaves of that species are always more or less narrowed to cuneate bases, whereas the base of our specimen is rounded-truncate. The general type of oak leaf with which ours may be somewhat more closely compared is represented by the Mexican species *Q. tepicana* Trelease; but the resemblance between them may be regarded merely as suggestive of possible closer relationship with the oaks of the southwest than with any of the eastern species.

Leaves referred to *Q. Prinus* were described and figured by Berry[22] from the Pleistocene of Alabama and North Carolina, and certain of the figures last cited (*loc. cit.*, figs. 6, 7) are suggestive of our specimen; but in each instance the narrower base serves to differentiate them.

A fossil leaf that bears a somewhat closer resemblance to ours, from the Pliocene of Italy, was described and figured by

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[22] Berry, E. W. (a) Pleistocene plants from Alabama. Amer. Naturalist, vol. 41, p. 693, pl. 1, fig. 5. Nov. 1907. (b) Pleistocene plants from North Carolina. U. S. Geol. Survey, Prof. Paper 140–C, p. 110, pl. 52, figs. 5–8. 1926.

Gaudin and Strozzi[23] and referred to *Fagus dentata* Goeppert;[24] but a comparison between the two figures shows the latter to be much more sharply dentate. The Italian specimen appears to represent a *Quercus* rather than a *Fagus,* and to represent the same general type of leaf as ours. Recently, also, a leaf that appears to be closely comparable with the latter species, from the Tertiary of Silesia, was described and figured by Kräusel,[25] and referred to *Castanea atavia* Unger.[26] Specific identity with Unger's species does not appear to be very striking, but the resemblance of Kräusel's specimen to ours appears to be very close. Foliar distinctions, in many instances, between fossil specimens representing the genera *Quercus, Fagus,* and *Castanea* are, however, not very obvious and, in connection with imperfect specimens it is, in certain instances, difficult to differentiate between them with certainty.

Quercus Schofieldii n. sp.

PLATE 33

Leaf apparently obovate in shape, approximately 17 centimeters in length by 8.5 centimeters in maximum width; margin finely and remotely dentate above, undulate below; nervation simply pinnate; midrib slender; secondaries alternate, subparallel, slightly flexuous, subtending uniform angles of approximately 45° with the midrib, each of the upper ones terminating in one of the marginal dentitions, just below which, from the upper side of each secondary, a branch extends upward in a series of irregular angled loops to the distal end of the secondary next above; tertiary nervation fine, close, uniform, approximately at right angles to the supporting secondaries throughout, mostly flexed, bent, or forked and connected, forming a network of irregular quadrilateral areola.

This specimen represents an oak that is manifestly of a different type from any of the species that are in existence in the eastern part of North America; but it is somewhat suggestive of the type of leaves found on certain of the Mexican and Central American species, such as *Quercus cyclobalanoides* Trelease, *Q. Galeottii* Martens, *Q. insignis* Martens & Galeotti, and *Q. oöcarpa* Liebmann; but none of these species has quite the fine denticulations that are characteristic of our leaves. For purposes of comparison, however, a leaf of *Q. Galeottii* is figured (PLATE 44, FIGURE 3), representing a specimen collected in Mexico.

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[23] Gaudin, C. T., & Strozzi, Carlo. Cont. flor. foss. Ital., Mém. 1 (Mémoire sur quelques gisements de feuilles fossiles de la Toscane), p. 32, pl. 6, fig. 5. 1858.

[24] Goeppert, H. R. Beiträge zur Tertiärflora Schlesiens, p. 18, pl. 2, fig. 3. 1852.

[25] Kräusel, Richard. Die Pflanzen des Schlesischen Tertiärs. Preuss. Geol. Landesanst., Jahrb. f. 1917 (vol. 38, pt. 2, no. 1/2), p. 130, pl. 12, fig. 14. 1919.

[26] Unger, Franz. Die fossile Flora von Sotzka. K. Akad. Wiss. [Wien], math.-naturwiss. Cl., Denkschr. vol. 2, p. 164 (34), pl. 31 (10), figs. 5–7. 1850.

A well-defined and unique fossil species that is strikingly similar to ours is *Quercus nevadensis* Lesquereux,[27] from the Tertiary (Miocene) gravels of California. Our specimens are larger than are those figured by Lesquereux, and the secondary nerves appear to be somewhat more ascending, but, except for the difference in size, it would not be easy to differentiate between them. In any event it is evident that they both belong to a type of oak that was characteristic of the western part of the North American continent in late Tertiary and, possibly, Quaternary time, and that their most nearly related existing species are, apparently, certain of those that now live in that region, further to the south.

Incidentally, in this connection, the following comments on *Q. nevadensis* by Lesquereux (*op. cit.*, p. 6) are of interest: "This species has not any marked relation with any [other] fossil one. By the nervation, and somewhat also by the form of the leaves, it is allied to *Q. castanea* Willd., of the present flora of North America, but still more to a section of Mexican Oaks, whose coriaceous leaves are bordered with short distant teeth: *Q. Humboldti, Q. glaucescens* Humb. and Bonpl., *Q. spicata* Kunth, etc."

The specific name is given in honor of Dr. S. J. Schofield, to whom we are indebted for the collection of the specimen.

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[27] Lesquereux, Leo. Mus. Comp. Zoöl. Harvard Coll., Mem. vol. 6, no. 2 (Report on the fossil plants of the auriferous gravel deposits of the Sierra Nevada), p. 5, pl. 2, figs. 3, 4. 1878.

Order URTICALES

Family ARTOCARPACEAE

Genus *Ficus Linnaeus*

FICUS INTERGLACIALIS Hollick

PLATE 34; PLATE 35

Ficus interglacialis Hollick, New York Bot. Gard., Jour. vol. 16, p. 44, pls. 152, 153. 1915.

"*Ficus* n. sp. (fruit)." Hollick, Summary Rept. (*loc. cit.*), p. 134.

The two plates, that represent a part of a fruiting branch of this species, are reproduced from those that served to illustrate the type specimen as above cited. PLATE 34 shows the specimen natural size. PLATE 35 shows the median part of the same specimen enlarged. It might be more or less satisfactorily compared with fruiting branches of any one of several existing species of fig, such as *Ficus tecolutensis* Miquel, native in Mexico, and *F. populoides* Warburg and *F. populnea* Willdenow, native in the West Indies, the last extending northward into Florida. In any event, its close specific relationship to this general type of fig can hardly be questioned.

Several species of *Ficus,* from Upper Cretaceous and Tertiary horizons, represented by fruit, have been described and figured but none of them indicates specific relationship with ours.

Ficus canadensis n. sp.

PLATE 36; PLATE 37, FIGURE 1

"*Ficus* n. sp. (leaf)." Hollick, Summary Rept. (*loc. cit.*), p. 134.

Leaves apparently oblong-ovate in shape, petiolate, entire-margined, with rounded or obscurely cordate bases and simple pinnate nervation. The secondary nerves are alternately arranged, subparallel, subtending uniform angles of about 45° with the midrib, ascending and curving upward in the marginal region. The petioles are stout and from 2 to 3 centimeters in length.

The original specimen upon which the generic identification was based is represented by the specimen figured on PLATE 36. The more complete specimen, represented by FIGURE 1 on PLATE 37, gives a better idea of the salient characters of the outline and main nervation; but the finer nervation, unfortunately, is not discernible. The specimens are comparable with leaves of several existing species of figs, especially with those of the general type represented by *Ficus Krugiana* Warburg, a species native in the West Indies (see PLATE 45); and among the hundreds of different fossil leaves that have been referred to the genus *Ficus* are a number that represent the same general type as ours; in fact, the number of comparisons that might be made, with existing and extinct species, is so numerous as to render them of no value in attempting to arrive at any satisfactory conclusions in regard to specific relationship or geologic age.

Whether or not these leaves and the fruit previously described under the name *Ficus interglacialis* may belong to one and the same species, must, of course, remain an open question until such time as the two may be found actually attached to the same branch; hence in the meantime I have given to each a distinctive specific appelation.

ORDER RANALES

Family MENISPERMACEAE

Genus *Cebatha* Forskal

Cebatha multiformis n. sp.

PLATE 38, FIGURES 1–6; PLATE 39, FIGURES 1–3

"*Cebatha* (*Cocculus*) n. sp." Hollick, Summary Rept. (*loc. cit.*), p. 134.

Leaves varying in shape and size, rounded subtriangular in shape, some slightly unsymmetrical, 6 to 9 centimeters in length by about the same in maximum width, broadest below the middle, rounded below, broadly truncate or curved and slightly oblique at the base, and occasionally abruptly cuneate in immediate proximity to the petiole; margins entire, lobed, or lobate-dentate; nervation 3-palmate from the base; lateral primaries branched from the outer sides, a basilar branch occasionally simulating a weak, exterior lateral primary, the branches all coalescing and becoming camptodrome in the marginal regions.

The type of foliage represented by these specimens is more abundant than any other in the collections from the Saint Eugene silts. Almost every piece of matrix contains remains more or less complete or fragmentary. Individual leaves differ so widely between themselves, in many instances, that the question of mutual specific identity might well be raised and, if found dissociated, either stratigraphically or geographically, they would probably be regarded as specifically distinct. In the silts, however, they are found not only closely associated but also, associated with them, are other specimens of leaves that show every possible gradation of form between the extremes, so that if a considerable series is arranged it is impossible to draw any satisfactory line or lines of demarkation between them.

Among existing genera in which heterophylly is a conspicuous feature may be noted certain ones in the Menispermaceae, especially *Cissampelos, Menispermum,* and *Cebatha* (*Cocculus*); and it is, in many instances, difficult to differentiate between these genera by means of the leaves alone. Comparison of our specimens, however, with a large number of leaves of species in these genera, particularly with those of the existing *Cebatha carolina* (Linnaeus) Britton, appeared to indicate a somewhat closer resemblance to the latter. This was my original generic identification (*loc. cit.*), based upon the specimens represented by FIGURES 1–3, PLATE 39, and it may be regarded as more or less significant that Berry[28] described and figured specimens from the Pleistocene of Kentucky, that closely resemble ours, which he identified as *Cebatha carolina* without question. Our specimens are larger in size; but otherwise it would be difficult to differentiate between them.

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[28] Berry, E. W. The Mississippi River bluffs at Columbus and Hickman, Kentucky, and their fossil flora. U. S. Natl. Mus., Proc. vol. 48, no. 2074, p. 300, pl. 12, figs. 3–5. 1915.

Genus *Cissampelos* Linnaeus

Cissampelos dubiosa n. sp.

PLATE 37, FIGURES 4, 5 (6, 7?); PLATE 39, FIGURE 4

"*Cissampelos?*" Hollick, Summary Rept. (*loc. cit.*), p. 135.

Leaves reniform in shape, slightly inequilateral, broader than long, 6.5 to 8 centimeters in maximum width by 4.5 to 6 centimeters in length, broadest below the middle, rounded below to a truncate, subcordate base; margin lobate-dentate, or coarsely crenate or wavy-dentate in the upper part, entire toward the base; nervation distinctly 3-palmate from the base, the lateral primaries branched from their outer sides, ascending, and supporting basilar secondaries that more or less simulate exterior lateral primaries, thus giving the appearance of 4- or 5-palmate nervation; secondary nervation camptodrome or obscurely paryphodrome.

Whether or not these leaves should be regarded as generically, or even as specifically distinct from *Cebatha multiformis,* the species last described, may perhaps be an open question. The specimen upon which the original generic identification was tentatively based (*loc. cit.*) is represented by FIGURE 4 on PLATE 39, which may be compared with the existing species *Cissampelos microcarpa* De Candolle (or *C. Pareira* Linnaeus?), represented by FIGURE 5, PLATE 46, drawn from a specimen collected on the island of Hispaniola. The specimen represented by FIGURE 3, PLATE 46, is another one of the same species, collected in Porto Rico, and this may be seen to compare so closely with our specimens represented by FIGURES 4 and 5, PLATE 37, that generic relationship, at least, can hardly be doubted.

The fragmentary specimens represented by FIGURES 6 and 7, PLATE 37, may belong either with *Cissampelos* or with *Cebatha,* or with *Menispermum,* and their inclusion under *Cissampelos dubiosa* is to be regarded as open to question.

The genus *Cissampelos* does not appear to have been recognized in paleobotany previous to its identification as an element in the flora of the Saint Eugene silts, hence there are no available descriptions or illustrations of any fossil forms with which comparisons with our specimens may be made.

In order that the difficulty attaching to any satisfactory generic identification of our specimens may be appreciated I have introduced (see PLATE 46) figures of leaves of *Cebatha carolina* (FIGURES 1 and 2), *Cissampelos Pareira* Linnaeus? (FIGURE 3), *Cissampelos fasciculata* Bentham (FIGURE 4), *Cissampelos microcarpa* De Candolle (FIGURE 5), *Menispermum canadense* Linnaeus (FIGURE 6), and *M. diversifolium* (Miquel) Prantl.

In the Old World a fossil species that compares very closely with certain of our specimens is *Cocculus latifolius* (Saporta) Saporta & Marion[29] (=*Menispermum latifolium* Saporta), from the Pliocene of France. A comparison of our FIGURE 1, PLATE 38, with Saporta's figure 6, plate 31 (*loc. cit.*), shows a somewhat striking resemblance; and it is of interest to note that Saporta also had difficulty in deciding between the genera *Menispermum* and *Cocculus* (=*Cebatha*), as to which one his species should be referred.

Incidentally, comparison may also be made between the lobed and lobate-dentate forms in our collection and certain leaves from the Miocene of Washington, described and figured by Knowlton[30] under the names *Populus heteromorpha* and *P. Fairii,* several of which present a remarkable resemblance to our FIGURES 3 and 4, PLATE 38, and FIGURE 1, PLATE 39, but whether or not there is any special significance in connection with this resemblance I would not venture to infer or suggest.

Order ROSALES

Family PLATANACEAE

Genus *Platanus* Linnaeus

Platanus pseudoccidentalis n. sp.

PLATE 40; PLATE 41; PLATE 42

"*Platanus* n. sp." Hollick, Summary Rept. (*loc. cit.*), p. 135.

Leaves trilobate, 20 to 23 centimeters in length by about the same in width; nervation 3-palmate, the lateral primaries suprabasilar, spreading; margin apparently sparingly and coarsely toothed, apparently developed below into a basilar appendage or alate border to the petiole.

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[29] Saporta, Gaston de & Marion, A. F. Recherches sur les végétaux fossiles de Meximieux. Mus. d'Hist. Nat. Lyon, Arch. vol. 1, p. 264, pl. 31, figs. 4–7; pl. 32, fig. 1. 1872.

[30] Knowlton. F. H. Flora of the Latah formation of Spokane, Washington, and Coeur d'Alene, Idaho, [in] Pardee, J. T., and Bryan, Kirk. Geology of the Latah formation, etc.: U. S. Geol. Survey, Prof. Paper 140–A, p. 30, pl. 12, figs. 8–10; pl. 13, figs. 1–7; pl. 14, figs. 1–3; pl. 15, figs. 3–5 [=*P. heteromorpha*]; pl. 15, fig. 2; pl. 16, figs. 1–3 [= *P. Fairii*]. 1926.

These leaves, which are abundantly represented in the collection, are surficially indistinguishable from those of the existing sycamore, *Platanus occidentalis* Linnaeus, of the Eastern United States. They are larger than the average-sized leaves on mature trees, but many individual leaves might be selected that would equal or exceed our specimens in size. The original specimens upon which the generic determination was based, are represented by the two figures, on PLATES 41 and 42, respectively.

Specimens that have been referred to *P. occidentalis* may be found described in a number of different papers that are concerned with Pleistocene deposits in various parts of North America. The species, or forms closely allied to it, appear to have been as abundantly represented and as characteristic of the Pleistocene flora as were species of *Fagus* identical with or closely allied to *F. grandifolia,* and the several species of *Hicoria.* A number of specimens, from Pleistocene deposits in Alabama and North Carolina, were described and figured by Berry;[31] and specimens that are apparently specifically identical with the latter, from the Pleistocene (Sunderland formation) of Maryland, were figured and referred by the writer[32] to *Platanus aceroides* Goeppert. All of these, however, are much smaller in size than are those from the Saint Eugene silts, but otherwise they are closely similar.

Platanus aceroides Goeppert,[33] as originally described and figured, was based upon specimens from the Miocene of Silesia; but subsequently a considerable diversity of forms, from both the New World and the Old, and ranging in age from the Eocene to the Miocene, and possibly Pliocene, were referred to the species by various authors.[34] Certain of these forms are undoubtedly identical with the species as originally described and figured by Goeppert, but others are of doubtful identity, and none is as large as ours.

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[31] Berry, E. W. (a) Pleistocene plants from Alabama. Amer. Naturalist, vol. 41, p. 696, pl. 2, fig. 5. Nov. 1907. (b) Pleistocene plants from North Carolina. U. S. Geol. Survey, Prof. Paper 140–C, p. 112, pl. 55, figs. 1–9. 1926.

[32] Hollick, Arthur. Md. Geol. Survey, Pliocene and Pleistocene, p. 231, pls. 73, 74. 1906.

[33] Goeppert, H. R. Die Tertiäre Flora von Schossnitz in Schlesien, p. 21, pl. 9, figs. 1–3. 1855.

A species that is, perhaps, more closely similar to ours, both in size and general appearance, is *Platanus dissecta* Lesquereux,[35] from the late Tertiary (probably Miocene) of the western United States; and the only apparent difference between them is that ours are prevailingly larger in size and with a somewhat more divergent or spreading character in connection with the lateral lobes.

Whatever may be thought of such surficial and minor differences as may be noted between the existing *Platanus occidentalis* and the three fossil forms *P. pseudoccidentalis, P. aceroides,* and *P. dissecta,* it is apparent that their resemblance to each other is so close that in certain instances satisfactory differentiation would be difficult, if not impossible, and hence it would be hazardous to regard any specimen of the general type of *Platanus* leaf to which they belong as a safe index fossil in critical stratigraphic work. All that may be safely said in this connection, as far as our specimens described and figured under the name *P. pseudoccidentalis* are concerned, is that they are more suggestive of certain Tertiary species than they are of any Quaternary species thus far described or depicted.

Incidentally, and for purposes of comparison, it may here be pertinent to call attention to two fossil leaves from the Pleistocene of the Don Valley, Toronto, Canada, that were described and figured by Penhallow,[36] under the names *Acer pleistoceni-*

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[34] Heer, Oswald. (a) Flora Tertiaria Helvetiae, vol. 2, pl. 87, figs. 3, 4; pl. 88, figs. 8, 11, 12. 1856. (b) Flora fossilis arctica, vol. 1, pl. 32 (Spitzbergen), figs. 1, 2. 1868. (c) *Idem,* vol. 4, No. 1 (Beiträge zur fossilen Flora Spitzbergens), pl. 17, figs. 1, 2; pl. 31, fig. 3. 1876. (d) *Idem,* vol. 7 (Greenland), pl. 90. 1883.

Berry, E. W. Fossil plants from the late Tertiary of Oklahoma. U. S. Natl. Mus., Proc. vol. 54, pl. 94, fig. 3; pl. 95, fig. 5. 1918.

[35] Lesquereux, Leo. Report on the fossil plants of the auriferous gravel deposits of the Sierra Nevada. Mus. Comp. Zoöl. Harvard Coll., Mem. vol. 6, no. 2, p. 13, pl. 7, fig. 12; pl. 10, figs. 4, 5. 1878.

[36] Penhallow, D. P. (a) Geol. Soc. America, Bull. vol. 1, p. 327, text fig. 1. Ap. 1890. (b) Amer. Naturalist, vol. 41, p. 443, text fig. 1 (reduced 0.55). 1907 (=*Acer pleistocenicum*). *Idem,* p. 444, text fig. 2 (reduced 0.55) (=*Acer torontoniense*).

cum and *A. torontoniense.* These leaves (see PLATE 47) I have reproduced, natural size, from photographs of the original specimens, kindly transmitted to me by Prof. J. H. White, of the University of Toronto. They represent the figures of the two species as originally depicted, reduced in size, by Penhallow, in the American Naturalist (*loc. cit.*). Our FIGURE 1 represents his single figure of *A. pleistocenicum,* and our FIGURE 2 the lower one of his two figures of *A. torontoniense.* The closer these specimens and photographs were studied, and the more extensively they were compared with species in the genera *Acer* and *Platanus,* the more certain it appeared that an error had been made in referring them to the former genus, and the more likely it appeared that their true generic relationship was with the latter. It may, indeed, be inferred that if Penhallow had not so referred them they would have been generally accepted as representing the genus *Platanus* and both, perhaps, merely as variant forms of *P. occidentalis.* The latter species was listed (*loc. cit.,* American Naturalist, p. 448) as an element in the Pleistocene flora of the Don Valley and elsewhere, but no specimen recognized as referable to either *Acer pleistocenicum* or *A. torontoniense* has been recorded from any locality other than the Don Valley.

In the course of correspondence had with Professor White, in relation to the specimens from the Don Valley, he referred, under date of February 3, 1913, to the two species in question as follows: ". . . I find I cannot see eye to eye with Penhallow in some of his identifications. . . . Penhallow's list is peculiar in containing but two extinct species, *Acer pleistocenicum* and *A. torontoniense.* . . . I should prefer to call both the above *Platanus.*"

In the circumstances I am inclined to regard the leaves that are included in these two species as representing a type of *Platanus* leaf that is characteristic of the Pleistocene of the Don Valley, and to utilize them for comparison with our much larger leaves from the Saint Eugene silts; and such comparison indicates that while the leaves from the two localities are apparently congeneric they must be regarded as specifically distinct and, apparently, each species representing a flora distinct from the other, either stratigraphic or regional.

Order RHAMNALES

Family VITACEAE

Genus *Vitis* Linnaeus

Vitis alia n. sp.

PLATE 43, FIGURE 1

"*Vitis* n. sp.?" Hollick, Summary Rept. (*loc. cit.*), p. 135.

Leaf about 11.5 centimeters in length by about 13.5 centimeters in maximum width, obscurely trilobate, deeply cordate at the base; margin coarsely and sharply dentate; nervation 3-palmate from the base, craspedodrome; lateral primaries subtending angles of about 45° with the midrib, profusely branched from the under sides, the basilar branches similarly branched from the under sides; main secondary nerves five on each side, subtending acute angles with the midrib, irregularly spaced and disposed, curving slightly upward and recurved as they terminate in the marginal dentitions.

This leaf resembles certain of the individual leaf forms of our existing native grapes, such as *Vitis riparia* Michaux, *V. cordifolia* Michaux, and *V. aestivalis* Michaux. It appears to be somewhat unequal-sided, one of the lateral primaries being curved inward toward its extremity and subtending a slightly more acute angle with the midrib than the other one, which latter is more divergent and almost straight distally.

It also appears to resemble the Eocene Tertiary species, *Vitis olriki* Heer,[37] originally described and figured in connection with a specimen from Greenland, and subsequently identified by Lesquereux,[38] from deposits of approximately equivalent age in Wyoming. In view, however, of the incomplete condition of our specimen it would be useless, and possibly misleading, to infer anything more than a resemblance to the general type of leaf which is represented by both the existing and the extinct species

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[37] Heer, Oswald. Flora fossilis arctica, vol. 1, p. 120, pl. 48, fig. 1. 1868.

[38] Lesquereux, Leo. U. S. Geol. Survey Terr., Rept. vol. 7 (The Tertiary flora), p. 241, pl. 41, fig. 8. 1878.

—a type which has apparently undergone but little modification in surficial characters since the time of its first appearance in connection with a species of the flora of early Tertiary time.

The genus *Vitis* is represented in a number of collections of Pleistocene plants, but heretofore only by the seeds,[39] and by a single tendril,[40] so that we have no leaf of any of these Pleistocene grapes with which to compare our specimen, and the extensive heterophylly that obtains in most of the existing species of grapes would render exact and satisfactory comparison with any one of them impossible. In the circumstances I have thought it the better course to describe our specimen as representing an extinct species, different from any heretofore recorded.

Order MALVALES

Family TILIACEAE

Genus *Tilia* Linnaeus

Tilia ? incerta n. sp.

PLATE 43, FIGURE 2

"Fragment of the lower part of a large leaf with well-defined lateral primaries, provisionally identified as belonging to the genus *Populus*." Hollick, Summary Rept. (*loc. cit.*), p. 135.

Leaf large, pinnately nerved, the two basilar secondaries apparently simulating lateral primaries, with branches from the undersides that branch and fork, the ultimate ramifications ending in the fine marginal dentitions.

This fragmentary specimen was originally regarded as probably belonging to a species of poplar (*loc. cit.*), having been compared with leaves from young shoots and saplings of the existing *Populus grandidentata* Michaux, and *P. heterophylla* Linnaeus, which are frequently 3-palmately nerved. Subsequent study and comparisons, however, resulted in the conclusion that the relation of the secondary nerves, especially the basilar ones, to the midrib was more nearly comparable with the characters of the lindens than with those of the poplars, and hence its present reference to the genus *Tilia.* Definite generic identification, however, from such a leaf fragment must be regarded as tentative only.

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[39] Berry, E. W. (a) Pleistocene plants from Virginia. Torreya, vol. 6, p. 89. 1906. (b) Contributions to the Pleistocene flora of North Carolina. Jour. Geology, vol. 15, p. 345. 1907. (c) Additions to the Pleistocene flora of New Jersey. Torreya, vol. 10, p. 265, text fig. 2 (*V. pseudorotundifolia* Berry), p. 266 (*V.* cf. *aestivalis* Michaux). 1910. (d) The fossil plants from Vero, Florida. Fla. State Geol. Survey, Ninth Ann. Rept. p. 28 (*V. austrina* Small?, or *V. coriacea* Shuttleworth?). 1917. (e) The fossil swamp deposit at the Walker Hotel site . . . Washington, D. C. Washington Acad. Sci., Jour. vol. 14, p. 21, pl. 2, figs. 6–9 (*V. cordifolia* Michaux). 1924.

Hollick, Arthur. Md. Geol. Survey, Pliocene and Pleistocene, p. 235. 1906.

[40] Berry, E. W. (a) The fossil plants from Vero, Florida, *loc. cit.* (*V.* cf. *rotundifolia* Michaux). (b) Pleistocene plants from North Carolina. U. S. Geol. Survey, Prof. Paper 140–C, p. 115, pl. 57, fig. 6. 1926.

The base of our leaf was, apparently, rounded-cordate. The midrib is stout, the marginal dentitions are fine, and the general appearance is suggestive of the leaves of the existing *Tilia americana* Linnaeus, and *T. heterophylla* Ventenat.

Several fossil species might also be mentioned as worthy of consideration, especially *Tilia populifolia* Lesquereux,[41] a Miocene Tertiary species from Colorado, and *T. speciosissima* Knowlton[42] from the Eocene of Colorado. *T. dubia* (Newberry) Berry (= *Tiliaephyllum dubium* Newberry),[43] from the Pleistocene clay of Fish House, New Jersey,[44] is similar to ours, but is not as suggestive as are the other two. The common form or type of leaf is so apparent in all, however, that their generic relationship can not be questioned. Leaves and fruit of *T. americana* were also listed, but without any illustration, by Penhallow,[45] in his contribution to the Pleistocene flora of the Don Valley, Toronto, Canada.

Elsewhere than on the North American continent the genus is also well represented in Tertiary deposits, by leaves that are, in many instances, closely similar to those of the several North American species previously mentioned, and it is apparent that certain closely similar foliar types of the genus have persisted from early Tertiary into the present time, and that specific differentiation and identification would be possible only in connection with well-preserved specimens, in which the critical distinguishing characters might be clearly visible.

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[41] Lesquereux, Leo. U. S. Geol. Survey Terr., Rept. vol. 8 (The Cretaceous and Tertiary floras), p. 179, pl. 34, figs. 8, 9. 1883.

[42] Knowlton, F. H., in Lee & Knowlton. U. S. Geol. Survey, Prof. Paper 101 (Geology and paleontology of the Raton Mesa and other regions in Colorado and New Mexico), p. 336, pl. 67. 1917.

[43] Newberry, J. S. U. S. Geol. Survey, Mon. vol. 26 (The flora of the Amboy clays), p. 109, pl. 15, fig. 5. 1895.

[44] This deposit was originally thought to be Cretaceous in age and was included in the Amboy clay series. It was subsequently determined to be of Pleistocene age. A. H.

[45] Penhallow, D. P., and others, in Report of the Committee . . . appointed to further investigate the flora and fauna of the Pleistocene beds in Canada. British Assoc. Adv. Sci., Bristol meeting, 1898, p. 528.

Order PARIETALES

Family Passifloraceae

Genus *Passiflora* Linnaeus

Passiflora canadensis n. sp.

Plate 37, figure 2

Leaf trilobate, approximately 3 to 4 centimeters in length by about the same in maximum width, wedge-shaped below, terminating in a narrow truncate-cordate base; lateral lobes relatively narrow; median lobe expanded toward the middle; sinuses deep and rounded; margin finely serrate-dentate; nervation 3-palmate, each lateral primary extending into one of the lateral lobes; secondary nerves irregularly spaced and disposed, branched toward the extremities, each main nerve and branch terminating in one of the marginal dentitions.

This is not a satisfactory specimen upon which to base a specific description or even a generic identification; but its general characters are too conspicuous and obvious to be ignored, and these are sufficiently well defined to indicate relationship with the genus *Passiflora,* and to enable tentative comparison to be made with certain of the leaf forms of the existing *P. incarnata* Linnaeus, the common red passion flower of the southern United States (see text-figure 1, introduced for comparison).

This is about as polyphyllous a genus as almost any one that could be named, and the leaves in a single species, and even on an individual plant, are often of most diverse forms, so that, as in connection with leaves of the Menispermaceae, a large number of comparisons are necessary in order to determine where the greatest similarity may be found between fossil and existing forms.

The genus has not been heretofore recognized in America in any deposits of Tertiary age. Several species were described and figured from the middle Tertiary of the Old World, but none of these could by any possibility be confused with our specimen, and no comparison between them or any further reference to them, is necessary. The genus *Passiflora,* as it exists to-day, is mostly tropical and semitropical in its distribution; but the species *P. incarnata,* which our specimen appears to resemble most closely, is native as far north as Virginia and Missouri, and is said to be hardy, in cultivation, somewhat further northward.

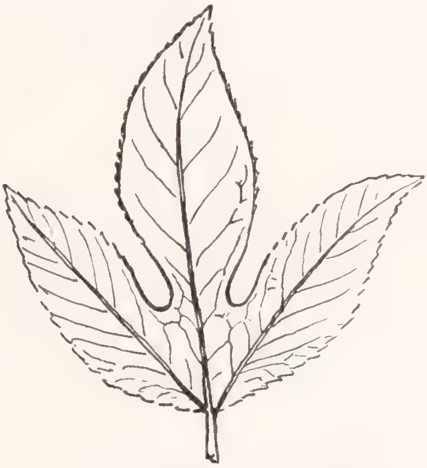

FIGURE 1. *Passiflora incarnata* Linnaeus. Campbell, Missouri. B. F. Bush, July 19, 1925. No. 141. Specimen in Herb. New York Bot. Gard. (Introduced for comparison.)

(GAMOPETALAE)

Order ERICALES

Family VACCINIACEAE

Genus *Vaccinium* Linnaeus

Vaccinium pseudocorymbosum n. sp.

PLATE 37, FIGURE 3

Leaf ovate-elliptical in shape, tapering above to an apiculate apex and rounded below to a cuneate base; margin minutely denticulate; nervation pinnate.

This leaf, although perfect in outline, does not show, clearly, the secondary nervation that might definitely determine its exact systematic status. In its general appearance, however, it is so strongly suggestive of the leaves of certain existing species of blueberry and huckleberry that I have but little hesitation in so referring it, generically. In particular it may be compared with leaves of *Vaccinium corymbosum* Linnaeus, which species was described and figured in the fossil form by the writer,[46] the identification being based upon specimens from deposits of Pleistocene age in Maryland.

Vaccinium corymbosum was also identified by Berry[47] in Pleistocene deposits of Alabama, Maine, and North Carolina; but in no instance do the figures of the specimens show any indication of the fine denticulation that characterizes ours. It should be noted, however, that leaves of *Vaccinium corymbosum*, in connection with its several forms or varieties, vary somewhat in shape and may be either entire or minutely denticulate.

Botanical discussion

An analysis of the flora of the Saint Eugene silts, thus far identified, indicates that it was composed mostly of dicotyledonous angiosperms. No trace of any gymnosperms, pteridophytes, or any lower forms of vegetation were discovered, and only fragmentary remains of two, generically unidentifiable, monocotyledons.

The Dicotyledonae number thirteen genera and sixteen species, all but one of which are included in the Choripetalae. The Fagales is the order most extensively represented, in which the family Betulaceae includes one species in the genus *Betula* and one in *Alnus*, and the Fagaceae two in *Fagus* and two in *Quercus*. The order Urticales is represented only by the Artocarpaceae, in which is included one genus, *Ficus,* containing two species. The order Ranales is represented only by the Menispermaceae, in which are included two genera, *Cebatha* and *Cissampelos,* each with a single species. All the other orders are represented each by a single family, genus, and species. These genera are *Hicoria, Platanus, Vitis, Tilia,* and *Passiflora.* The only representative of the Gamopetalae is a single species of *Vaccinium.*

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[46] Hollick, Arthur. Md. Geol. Survey, Pliocene and Pleistocene, p. 236, pl. 69, figs. 7–9. 1906.

[47] Berry, E. W. (a) Additions to the Pleistocene flora of Alabama. Amer. Jour. Sci. vol. 29, p. 398. 1910. (b) Pleistocene plants in the marine clays of Maine. Torreya, vol. 17, p. 161, text fig. 1. 1917. (c) Pleistocene plants from North Carolina. U. S. Geol. Survey. Prof. Paper 140–C, p. 116, pl. 57, figs. 8, 9. 1926.

The species most abundantly represented by actual number of specimens are *Cebatha multiformis, Cissampelos dubiosa, Fagus sanctieugeniensis,* and *Platanus pseudoccidentalis.* These four species appear to form the bulk of the flora. The species that are next most abundant are *Hicoria pseudovata, Betula ulmoides,* and *Ficus interglacialis.* The remaining species appear to be relatively negligible in numerical importance.

In most instances the species are more or less closely similar to existing species, as far as surficial resemblance is concerned; and generic identity is clearly indicated in almost every instance. In this connection, for purposes of ready reference and comparison, between the fossil species and the existing species that resemble them most closely, the following table may be found convenient:

Flora of the Saint Eugene Silts

Alphabetical list of species	Existing species of closest surficial resemblance
Alnus sp.	*Alnus oblongifolia* Torrey. *A. serrulata* Willdenow. *A. fruticosa* Ruprecht. *A. rotundifolia* Miller.
Betula ulmoides n. sp.	*Betula lenta* Linnaeus. *B. cordifolia* Regel. *B. lutea* Michaux f.
Cebatha heterophylla n. sp.	*Cebatha carolina* (Linnaeus) Britton. *Menispermum canadense* Linnaeus.
Cissampelos dubiosa n. sp.	*Cissampelos Pareira* Linnaeus.
Fagus sanctieugeniensis n. sp.	*Fagus grandifolia* Ehrhart.
Fagus sp.	*Fagus sylvatica* Linnaeus.
Ficus canadensis n. sp.	*Ficus Krugiana* Warburg.
Ficus interglacialis Hollick.	*Ficus populnea* Willdenow. *F. tecolutensis* Miquel. *F. populoides* Warburg.
Hicoria pseudovata n. sp.	*Hicoria ovata* (Miller) Britton. *H. glabra* (Miller) Britton.
Monocotyledon (leaf?) gen. et sp.?	

Monocotyledon (culm or petiole?) gen. et sp.?	
Passiflora canadensis n. sp.	*Passiflora incarnata* Linnaeus.
Platanus pseudoccidentalis n. sp.	*Platanus occidentalis* Linnaeus.
Quercus kootenayensis n. sp.	*Quercus tepicana* Trelease. *Q. Prinus* Linnaeus.
Quercus Schofieldii n. sp.	*Quercus Galeottii* Martens. *Q. insignis* Martens and Galeotti. *Q. cyclobalanoides* Trelease. *Q. oöcarpa* Liebman.
Tilia? incerta n. sp.	*Tilia americana* Linnaeus. *T. heterophylla* Ventenat.
Vaccinium pseudocorymbosum n. sp.	*Vaccinium corymbosum* Linnaeus.
Vitis alia n. sp.	*Vitis aestivalis* Michaux. *V. riparia* Michaux. *V. cordifolia* Michaux.

From the viewpoint of geographical distribution an analysis of the flora represented by the existing genera in the above list is of interest, especially in connection with the climatic conditions that they indicate.

The genus *Alnus* is common to both the Old World and the New, in the northern hemisphere, extending southward along the mountains of Central and South America to the equatorial region. *A. oblongifolia* is native in Arizona, New Mexico, and Mexico. *A. serrulata* is distributed throughout the eastern United States to as far north as Minnesota. *A. fruticosa* (= *A. sitchensis* Sargent?) is apparently limited in its distribution to Yukon Territory, Alaska, and Eastern Siberia. *A. rotundifolia* (= *A. glutinosa* Gaertner) is a European species.

The genus *Betula* is of north temperate and boreal distribution, in both the Old World and the New. *B. lenta* occupies a region that embraces Newfoundland and Ontario on the north to Florida and Tennessee on the south. *B. cordifolia* ranges from Newfoundland to British Columbia, southward to Maine, northern New York, and Iowa. *B. lutea* has a distribution that includes Newfoundland to Manitoba in the north, to as far south as the latitude of Pennsylvania.

Cebatha is a cosmopolitan genus of tropical and subtropical distribution. *C. carolina* is scattered throughout the eastern United States northward to Illinois.

Cissampelos is a generic element in the tropical floras of Africa and America. *C. Pareira,* in its numerous forms, is native in northern South America and the West Indies, and may be regarded as a strictly tropical type of vegetation.

The genus *Fagus* includes three recognized species, all of them limited in their distribution to the Northern Hemisphere. *F. grandifolia* (= *F. americana* Sweet) is the only species native in America. It ranges from Nova Scotia westward to Wisconsin, southward to Texas and eastward to the Atlantic coast. *F. sylvatica* is a European species.

Ficus is a cosmopolitan genus, widely distributed throughout the tropical regions of both the Old World and the New. *F. Krugiana* is native in the West Indies; *F. populnea* extends as far north as Florida; *F. tecolutensis* is a Mexican species; *F. populoides* is West Indian.

Hicoria is a strictly North American genus, including one Mexican species and about a dozen native in the eastern part of the continent, from Quebec, Ontario, and Minnesota, southward. *F. glabra* (= *Carya porcina* Nuttall) and *F. ovata* (= *Carya alba* Nuttall) all have approximately the same range from Minnesota to Texas and eastward to the Atlantic coast.

Passiflora is cosmopolitan in its distribution in tropical and subtropical regions, a few species extending into the temperate zones. *P. incarnata* is included among the latter, having a distribution in the eastern United States that extends from the Gulf States to about the latitude of Virginia and Missouri.

The genus *Platanus* is an element in the flora of the north temperate regions of the Old World and the New, one species extending southward, in the mountains, into Mexico. *P. occidentalis* ranges throughout eastern North America from Maine to Ontario southward, and eastward from Nebraska to Texas.

The genus *Quercus* is subtropical to subboreal in its distribution, in Eurasia and North America, extending southward into the Southern Hemisphere by way of the mountains of Mexico, Central and South America. *Q. Prinus* is an eastern North American species, ranging from Maine to Ontario and southward to Tennessee, Alabama, and Georgia. *Q. tepicana, Q. Galeottii, Q. insignis,* and *Q. cyclobalanoides* are Mexican species, and *Q. oöcarpa* is a native of Central America.

Tilia is a genus that is confined to the Northern Hemisphere in both the Old World and the New. In North America one species is known, in the mountains of Mexico, otherwise the genus is confined to the eastern part of the continent. *T. americana* ranges from Georgia and Texas in the south to New Brunswick and Manitoba in the north, and *T. heterophylla* northward from the Gulf States to New York and westward to Illinois and Tennessee.

The genus *Vaccinium,* even in its modern limited definition, has a wide geographic distribution in the subtropical to boreal zones of the Northern Hemisphere, both in the Old World and the New, and extending southward in the mountainous regions of India and South America. *V. cormybosum,* in its various varieties or forms, ranges from Newfoundland to Minnesota southward to the Gulf States.

Vitis is a cosmopolitan genus, native in the tropical and temperate zones of both the Eastern and the Western Hemispheres. *V. aestivalis* ranges throughout eastern North America from Ontario, Wisconsin, and Louisiana to the Atlantic coast. *V. riparia* (= *V. vulpina* Linnaeus) ranges from Nova Scotia to Manitoba southward to Maryland and Arkansas, and *V. cordifolia* from New England to Nebraska southward to the Gulf States.

A flora composed of or including the above generic and specific elements would be broadly recognized as prevailingly New World in its general facies, and as overwhelmingly representative of the Northern Hemisphere; but a critical analysis of these elements, in detail, reveals certain other features of geographic and zonal distribution that are interesting.

The first feature that will naturally attract attention is the presence of tropical elements, represented by the genera *Cissampelos, Ficus,* and *Passiflora,* and the subtropical genus *Cebatha.* The presence of these genera, if it has any climatic significance attaching to it, indicates at least a subtropical temperature. The other genera (*Alnus, Betula, Hicoria, Platanus, Quercus, Tilia, Vaccinium,* and *Vitis*) possess but little climatic significance as they are all represented in temperate as well as in subtropical regions. In general, it may be said that it would be justifiable to infer that such a flora would be indicative of climatic conditions that now prevail in North America approximately 900 miles further south than British Columbia.

If the floral elements, especially the specific elements, are next analyzed in connection with their east and west distribution, it may be seen that the flora as a whole is more nearly comparable with that of eastern rather than with that of western North America. *Cebatha carolina* does not extend farther west than Kansas; *Menispermum canadense* is not recorded from farther west than Manitoba; *Passiflora incarnata* no farther west than Missouri; and *Vaccinium corymbosum* no farther than Minnesota. *Fagus grandifolia,* the only existing American species of the genus, does not extend farther west than Wisconsin; and of the dozen or more recognized species of *Hicoria* none extends farther west than Minnesota, Kansas or Texas, with the exception of one southern species that occurs in Mexico. The genus *Platanus* has a distribution similar to that of *Hicoria. P. occidentalis* occurs throughout the eastern United States to as far west as Nebraska and Texas, and the only other two American species are natives of the mountainous regions of the extreme southwest and Mexico. The genus *Tilia,* which includes nine American species, is also representative of the east rather than the west. Of these *T. americana* alone extends as far west as Manitoba; and one species is native in the mountains of Mexico.

Of the three species of *Vitis* listed, one, *V. riparia,* ranges westward as far as Manitoba, the others to Wisconsin and Nebraska.

Of the three American species of *Alnus* listed, and the three of *Betula,* only *A. fruticosa* and *B. cordifolia* have a far western distribution.

The six species of *Quercus* listed appear to be more or less anomalous elements in the flora. Five are representative of Mexico and Central America, and only one (*Q. Prinus*) is eastern in its distribution; and this species is somewhat doubtfully included.

If therefore, we are warranted in assuming as valid the comparison of the above generic and specific elements with the similar elements identified in the flora of the Saint Eugene silts, the latter may be regarded as representing a flora approximating that now in existence in the eastern United States, from about latitude 38° southward.

Geological discussion

An analysis of the specific elements included in the flora of the Saint Eugene silts, in connection with fossil species with which they may be most closely compared, does not produce conclusive results as to the probable stratigraphic position or exact geologic age of the silts. That the flora is evidently a very recent one can not be questioned; but it is different in its general features as well, apparently, as in its specific elements, from any fossil flora heretofore described; hence no satisfactory correlation is possible. In order, however, to assist in this connection the following table is given:

Flora of the Saint Eugene Silts

Alphabetical list of species	Fossil species apparently most closely allied
Alnus sp.	*Alnus rotundifolia* Miller (= *A. glutinosa* Gaertner). Miocene?, Pliocene, Pleistocene, and Modern.
	Alnus rugosa K. Koch (= *A. serrulata* Willdenow). Pleistocene and Modern.
	Alnus serrulata fossilis Newberry. Tertiary (Oligocene?).
Betula ulmoides n. sp.	*Betula lutea* Michaux f. Pleistocene and Modern.
Cebatha multiformis n. sp.	*Cebatha carolina* (Linnaeus) Britton. Pleistocene and Modern.
	Cocculus latifolius Saporta & Marion. Tertiary (Pliocene).
Cissampelos dubiosa n. sp.	
Fagus sanctieugeniensis n. sp.	*Fagus grandifolia* Ehrhart. Pleistocene and Modern.
	Fagus Antipofii Abich. Tertiary (Oligocene?).
	Fagus deucalionis Unger. Tertiary Eocene?).
	Fagus macrophylla Unger. Tertiary (Eocene?).
Fagus sp.	*Fagus sylvatica fossilis* Laurent & Marty. Tertiary (Pliocene).
Ficus canadensis n. sp.	
Ficus interglacialis Hollick.	
Hicoria pseudovata n. sp.	*Hicoria ovata* (Miller) Britton. Pleistocene and Modern.
	Hicoria glabra (Miller) Britton. Pleistocene and Modern.
	Hicoria pseudoglabra Hollick. Pleistocene.

Monocotyledon (leaf?) gen. et sp.?	
Monocotyledon (culm or petiole?) gen. et sp.?	
Passiflora canadensis n. sp.	
Platanus pseudoccidentalis n. sp.	*Platanus occidentalis* Linnaeus. Pleistocene and Modern. *Platanus aceroides* Goeppert. Pleistocene and Tertiary (Miocene). *Platanus dissecta* Lesquereux. Tertiary (Miocene).
Quercus kootenayensis n. sp.	*Quercus Prinus* Linnaeus. Pleistocene and Modern. *Fagus dentata* Goeppert. Tertiary (Pliocene). *Castanea atavia* Unger. Tertiary (Miocene).
Quercus Schofieldii n. sp.	*Quercus nevadensis* Lesquereux. Tertiary (Miocene).
Tilia? incerta n. sp.	*Tilia americana* Linnaeus. Pleistocene and Modern. *Tilia dubia* (Newberry) Berry. Pleistocene. *Tilia populifolia* Lesquereux. Tertiary (Miocene). *Tilia speciosissima* Knowlton. Tertiary (Eocene).
Vaccinium pseudocorymbosum n. sp.	*Vaccinium corymbosum* Linnaeus. Pleistocene and Modern.
Vitis alia n. sp.	*Vitis Olriki* Heer. Tertiary (Eocene).

An analysis of the above table indicates that, as far as a majority of its generic elements are concerned, the flora of the Saint Eugene silts might be regarded as Pleistocene in age; and certain of the genera most abundantly represented by actual number of specimens (*Fagus, Hicoria,* and *Platanus*) are also among the most characteristic genera of recognized American Pleistocene deposits. Specifically, however, the flora can not be satisfactorily correlated with any Pleistocene flora heretofore described. All of the species are, apparently, new to science, and their prevailingly large size indicates a more luxuriant or vigorous growth than is indicated by figures of related species recorded and described as Pleistocene in age in connection with any American deposits. The specific elements might represent a Tertiary flora, as far as their general surficial characters are concerned. Unfortunately, however, our knowledge of the Pliocene flora, especially the American Pliocene, is exceedingly limited,[48] and hence we have a very unsatisfactory concept of the North American flora that was intermediate between that of the Miocene and that of the Pleistocene. We also know relatively little of the American Pleistocene floras, compared with the extensive knowledge that has been acquired of the floras of the same period in Europe; hence satisfactory paleobotanical data for correlation purposes are meager and inconclusive.

Dawson, Penhallow, and other Canadian geologists[49] recognized three distinct Pleistocene climatic periods, viz.:

3. Green's Creek: Mild. About the equivalent of that of the northern United States at the present time.

2. Scarboro: Cold. About the equivalent of that of Labrador at the present time.

1. Don: Warm temperate. About the equivalent of that of the middle eastern United States at the present time.

Of the seventy-five species of fossil plants listed in these reports (*loc. cit.*) all are living, with one exception (*Acer pleistocenicum* Penh.), and all have a wide geographic and climatic range, with one exception (*Quercus oblongifolia* Torr., confined to California). The species of greatest southern range, which may be regarded as indicating warm-temperature conditions in connection with the Don flora are:

Chamaecyparis sphaeroidea Spach [=*C. thyoides* (L.) B. S. P.]. Mississippi to Massachusetts.

Juniperus virginiana L. West Indies and Arizona to New Brunswick.

Quercus obtusiloba Michx. [=*Q. minor* (Marsh.) Sarg.] Texas to Missouri, and cultivated in the northern states.

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[48] Only two papers of any importance have been published, viz.: (a) A Pliocene flora from the coast ranges of California. Harold Hannibal. Torrey Bot. Club, Bull. vol. 38, pp. 329–342. July, 1911. (b) The flora of the Citronell formation. E. W. Berry. [In] Matson, G. C., and Berry, E. W. The Pliocene Citronelle formation of the Gulf coastal plain and its flora. U. S. Geol. Survey, Prof. Paper 98–L, pp. 193–208, pls. 44–47. 1916.

[49] Dawson, J. W., Penhallow, D. P., and others. (a) Canadian Pleistocene flora and fauna: Report of the committee . . . appointed to further investigate the flora and fauna of the Pleistocene beds in Canada. British Assoc. Adv. Sci., Rept., Bristol meeting, 1898, pp. 522–529. (b) *Idem,* Sec. C., Bradford meeting, 1900, pp. 328–339.

Maclura aurantiaca Nuttall (=*Toxylon pomiferum* Rafinesque). Texas to Missouri, and cultivated in the northern states.

Asimina triloba (L.) Dunal. Florida to Ontario.

Fraxinus quadrangulata Michx. Alabama to Ontario.

None of these, however, as may be seen from their respective ranges of distribution, is a strictly southern species and none is represented in the Kootenay Valley flora, although the genera *Alnus, Hicoria,* and *Platanus* are common to both the Don and the Kootenay. On the other hand the genera *Ficus, Cebatha, Cissampelos,* and *Vitis* are elements in the Kootenay but not in the Don. The conclusion, therefore, appears to be justified that if the Kootenay Valley flora is of Pleistocene age it must represent an interglacial period distinct from and of a warmer climate than either the Don, the Scarboro, or the Green's Creek, or else that these periods represent colder regional conditions than those which prevailed further west, and that the Kootenay flora was a regional phase of one of these. And in this connection it is of interest to note that the Cretaceous and Tertiary floras of the Northwest contain a larger number of tropical elements than do the contemporaneous floras of the middle and eastern parts of the continent; and, finally, we know that at the present time the climatic conditions in British Columbia are milder than those of Ontario,[50] and I am informed, by those who are conversant with the facts, that a critical examination and comparison of their respective living floras shows similar regional differences.

In summary it may be said that the flora of the Saint Eugene silts, to the extent that it has thus far been investigated, apparently represents one heretofore undescribed, and that it is indicative of Tertiary rather than of post-Tertiary age; but that additional information would be necessary in order to compare it satisfactorily with any described flora of either age, from either the New World or the Old.

[50] *Note.* Saint Eugene Mission (49° 30′ N. Lat.) has an annual mean temperature of 47° Farh. The Don River valley (43° 45′ N. Lat.) has an annual mean temperature of 41° Farh. In other words the Saint Eugene Mission, about 375 miles further north than the Don River region, has a mean annual temperature 6° warmer.

PLATE 29

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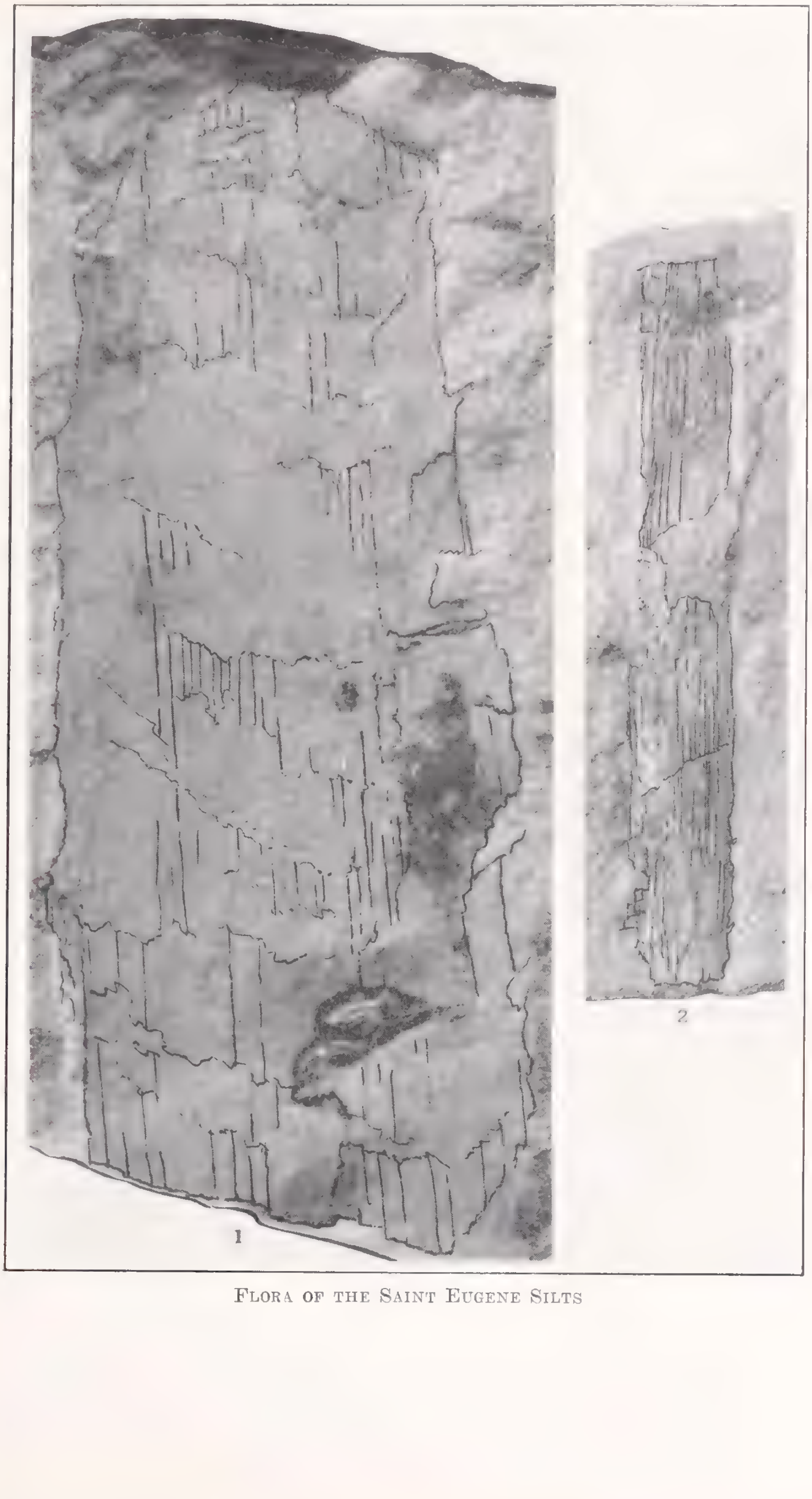
FIGURE 1.	Monocotyledon (leaf?) gen. et sp.?	394
FIGURE 2.	Monocotyledon (culm or petiole?) gen. et sp.?	394



FLORA OF THE SAINT EUGENE SILTS

PLATE 30

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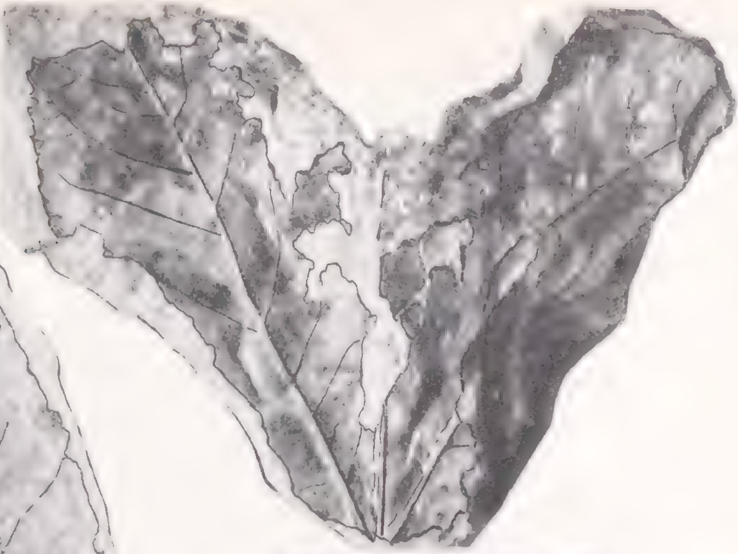
Figure 3. *Fagus sanctieugeniensis* n. sp.	399
Figure 4. *Fagus* sp.	401



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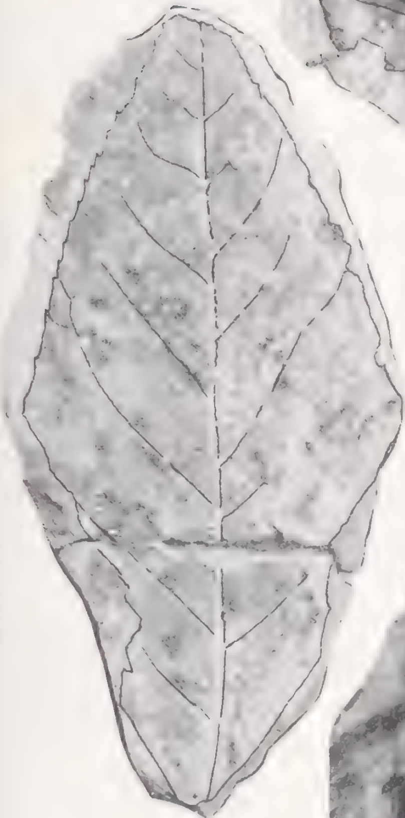

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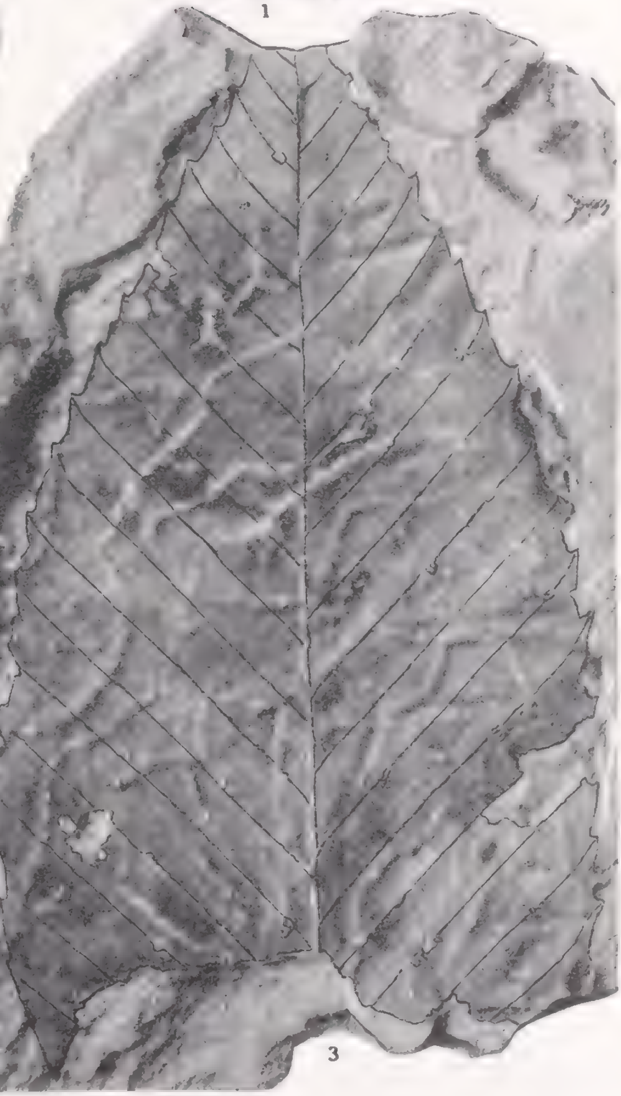

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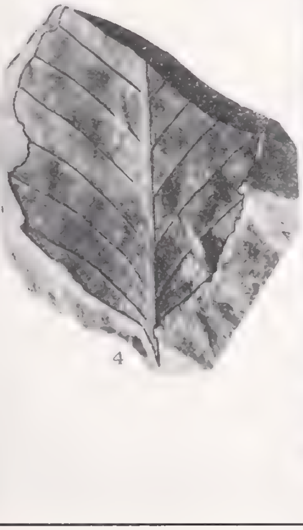

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Flora of the Saint Eugene Silts

PLATE 31

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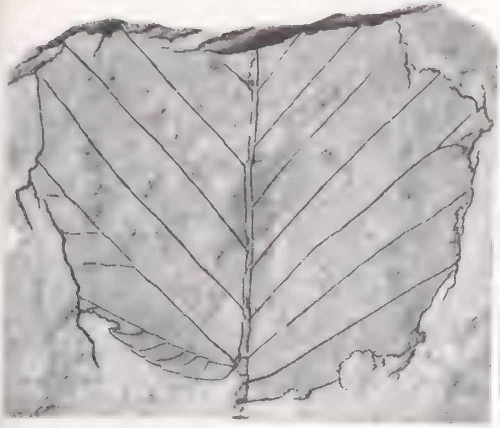
FIGURE 2.	*Alnus* sp.	398
FIGURE 3.	*Fagus sanctieugeniensis* n. sp.	399



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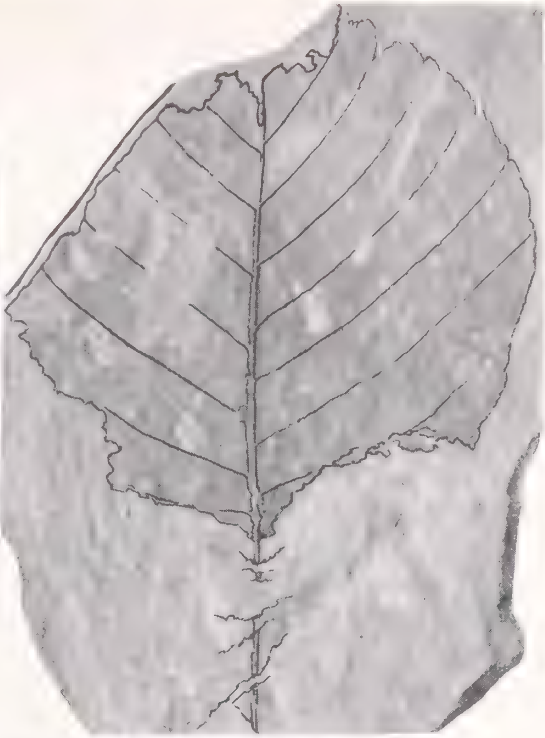

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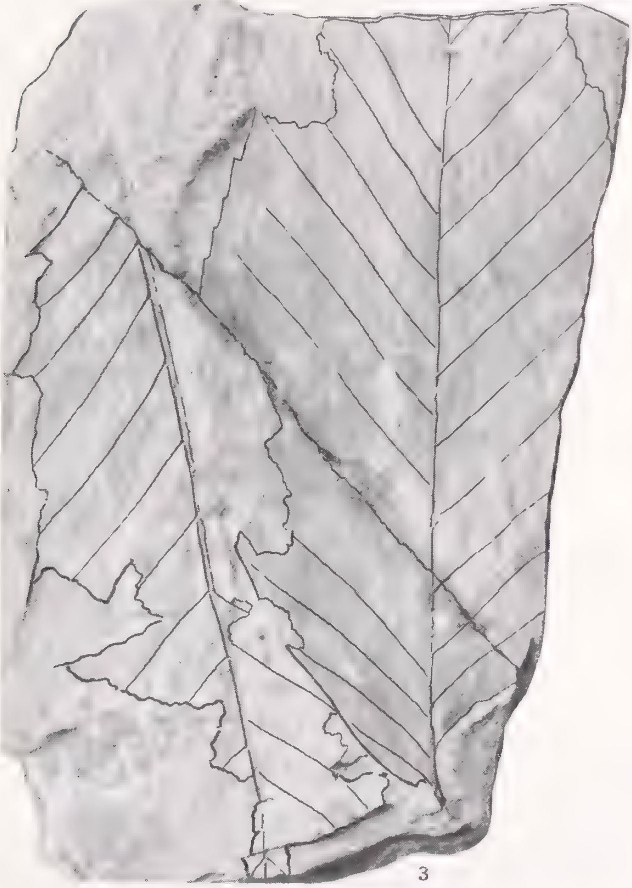

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Flora of the Saint Eugene Silts

PLATE 32

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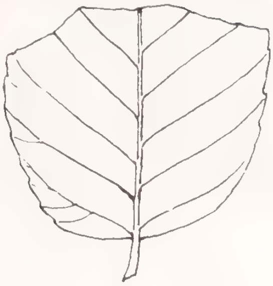
FIGURE 1. *Betula ulmoides* n. sp.	397
FIGURES 2, 3. *Fagus sanctieugeniensis* n. sp.	399
FIGURE 4. *Quercus kootenayensis* n. sp.	402



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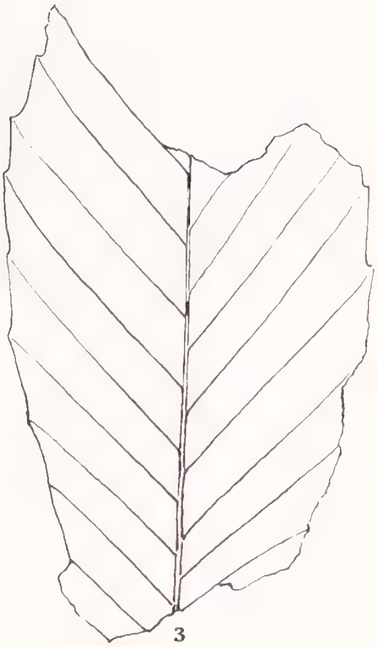

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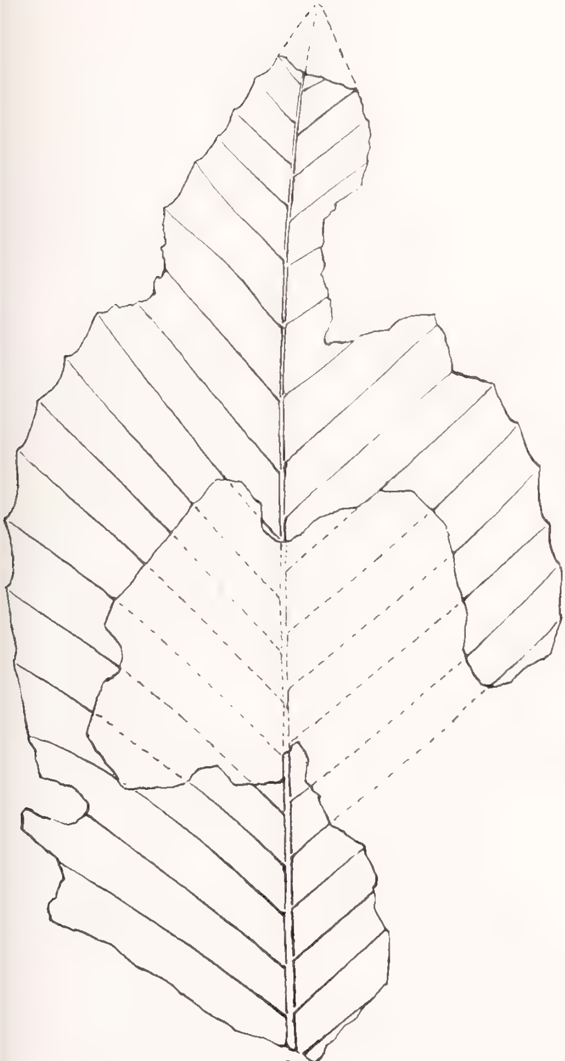

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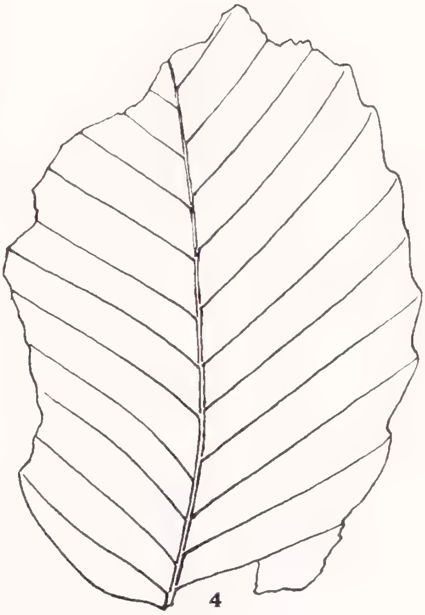

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Flora of the Saint Eugene Silts

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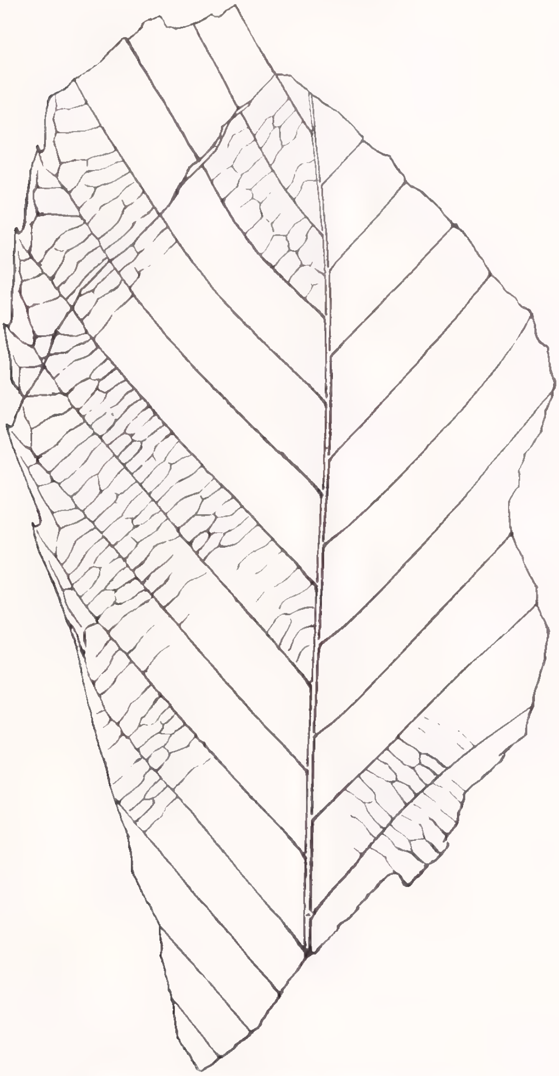
Quercus Schofieldii n. sp. 403



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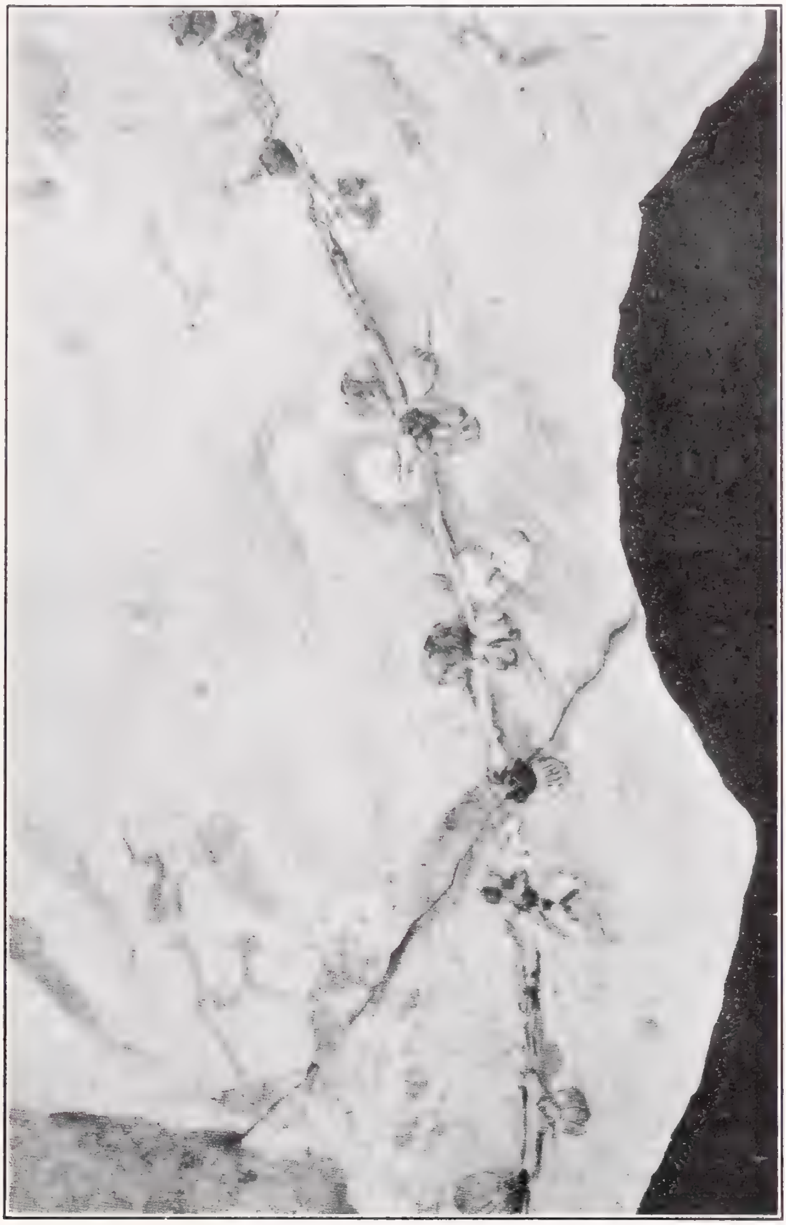
Ficus interglacialis Hollick (nat. size)	405



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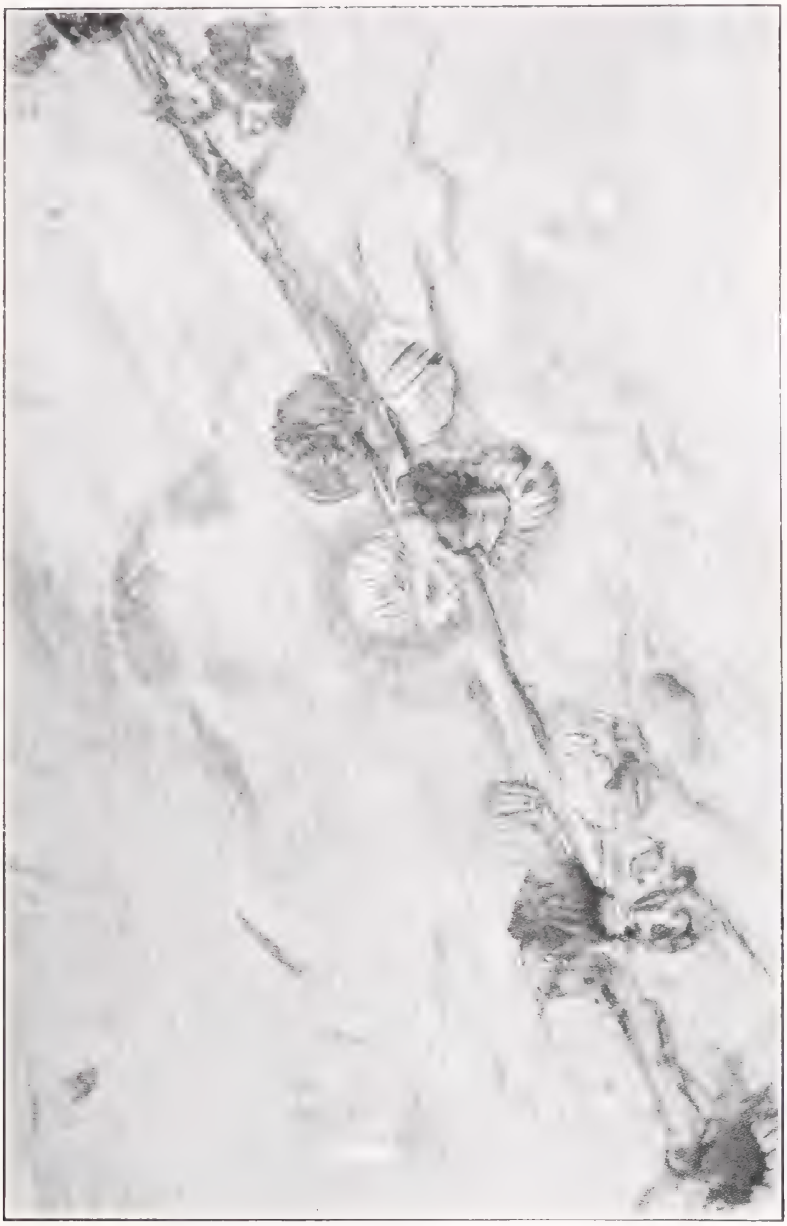
Ficus interglacialis Hollick (enlarged)	405



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Ficus canadensis n. sp. 405

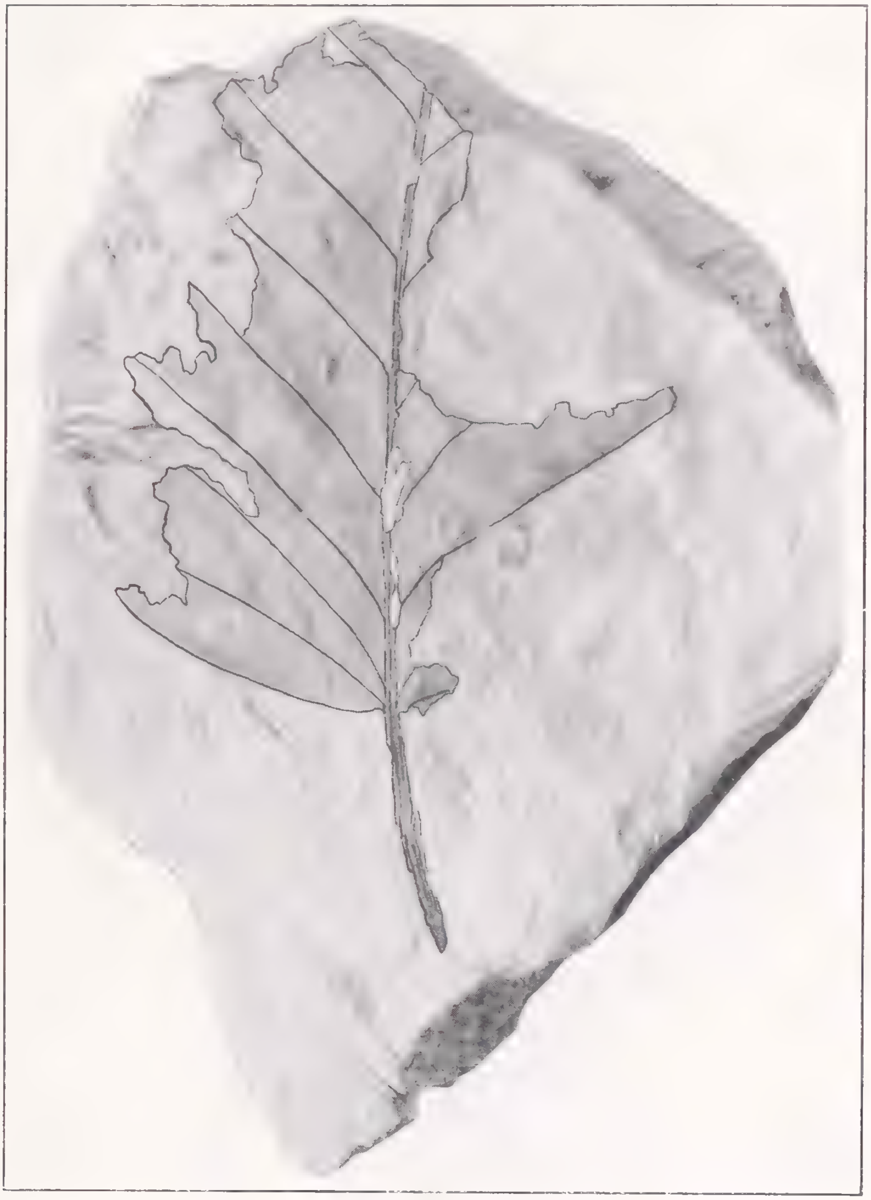

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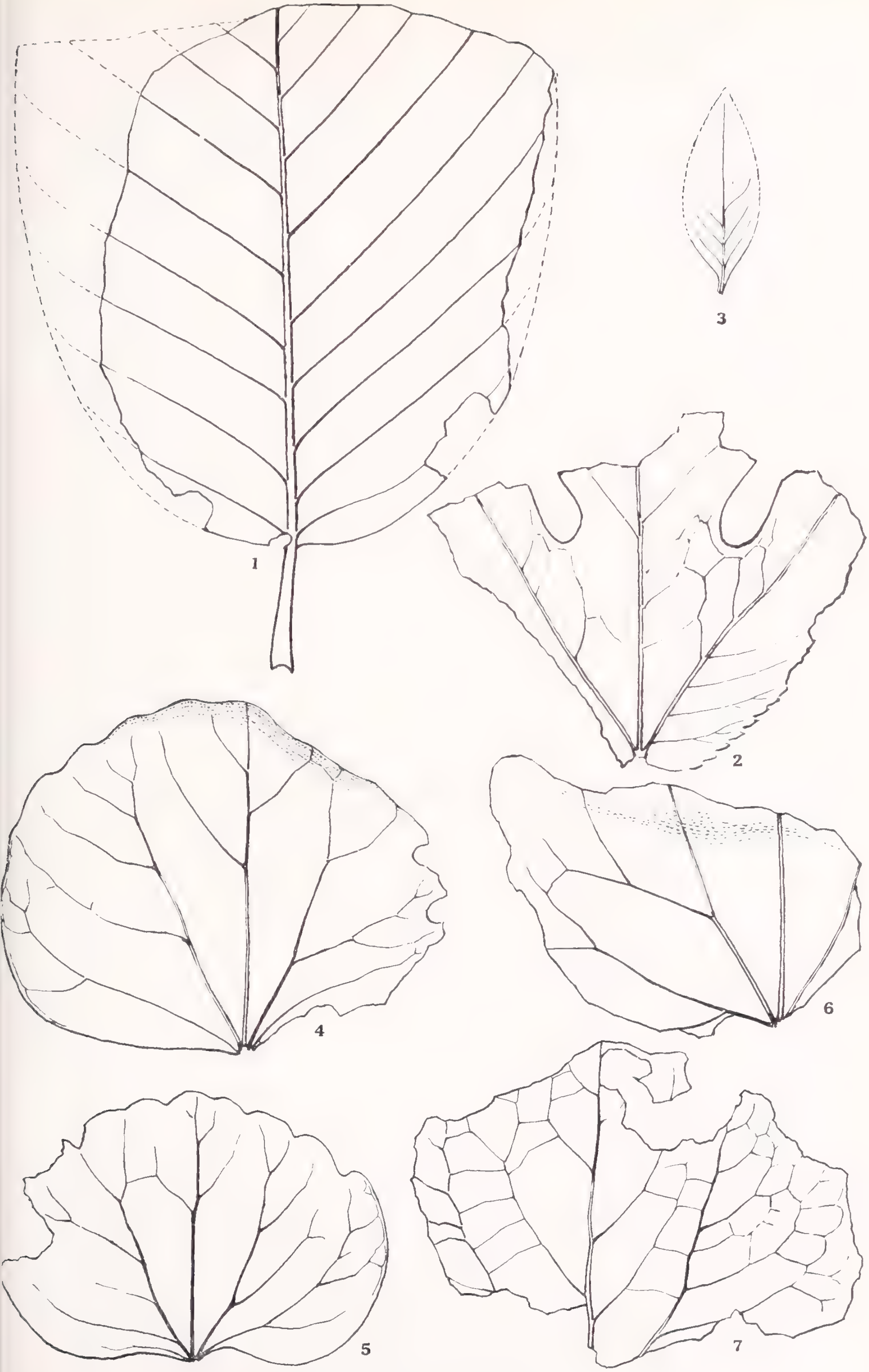
FIGURE 2. *Passiflora canadensis* n. sp. 416
FIGURE 3. *Vaccinium pseudocorymbosum* n. sp. 417
FIGURES 4, 5 (6, 7?). *Cissampelos dubiosa* n. sp. 408



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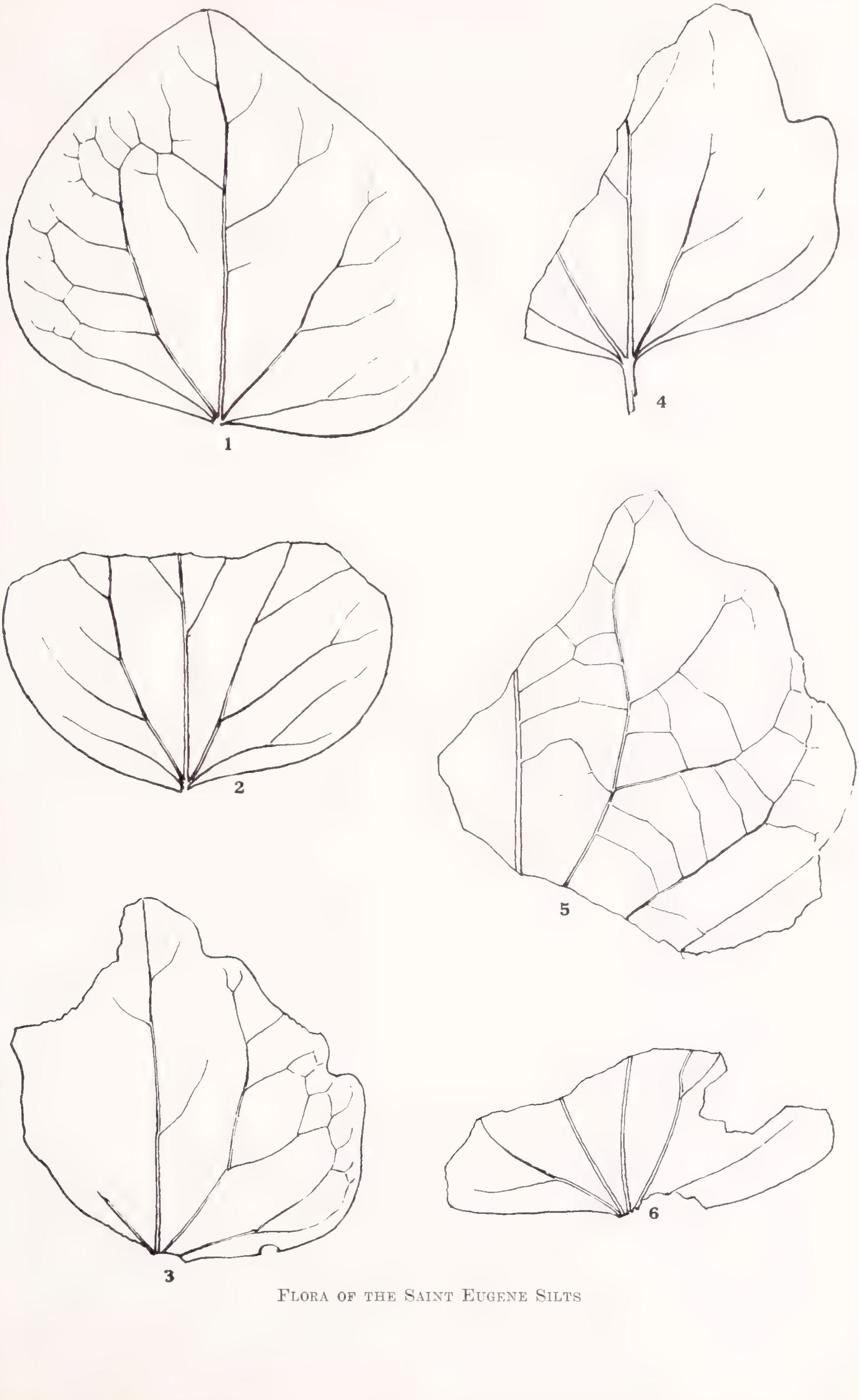

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PLATE 39

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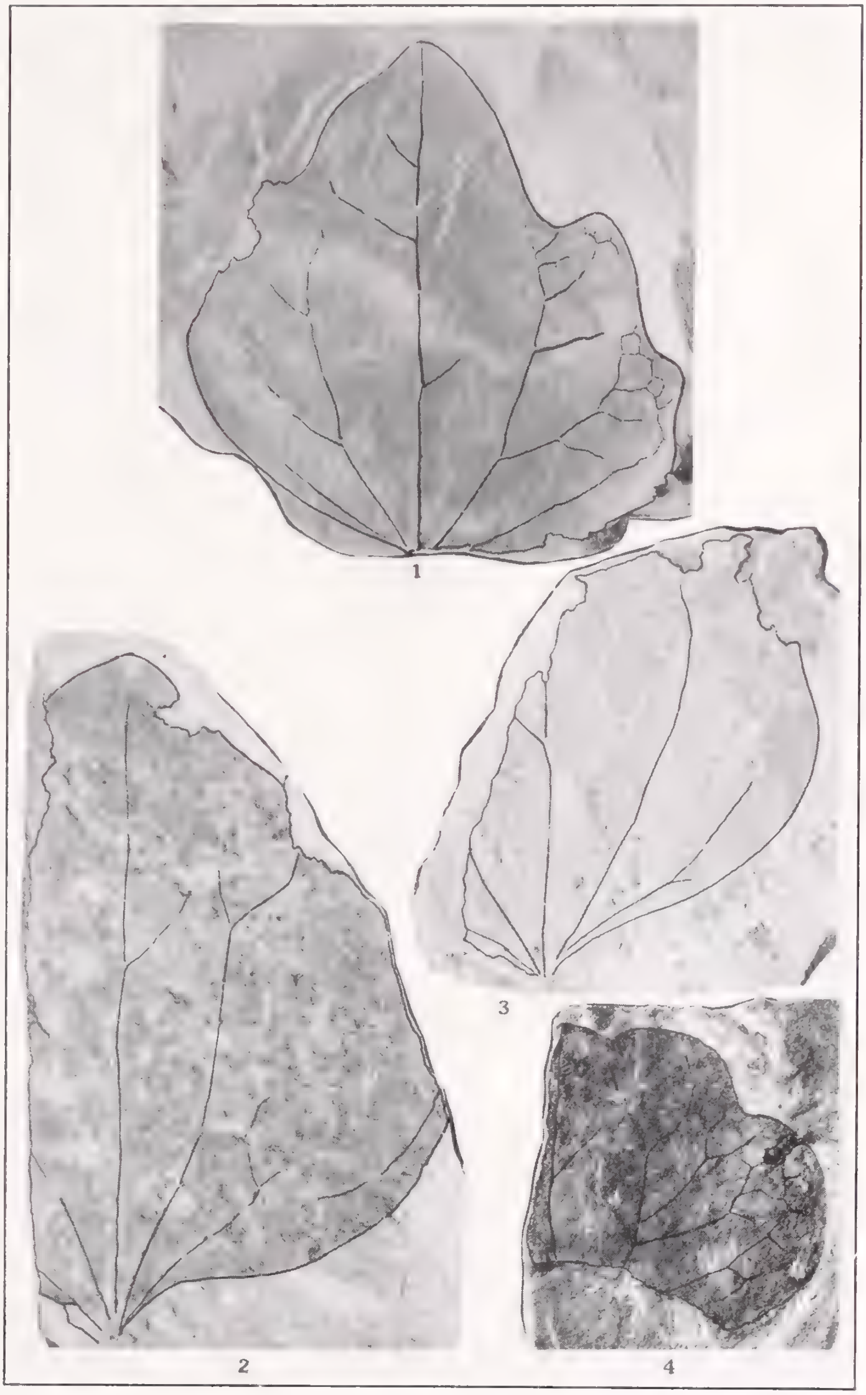
FIGURES 3. *Cissampelos dubiosa* n. sp. .	408



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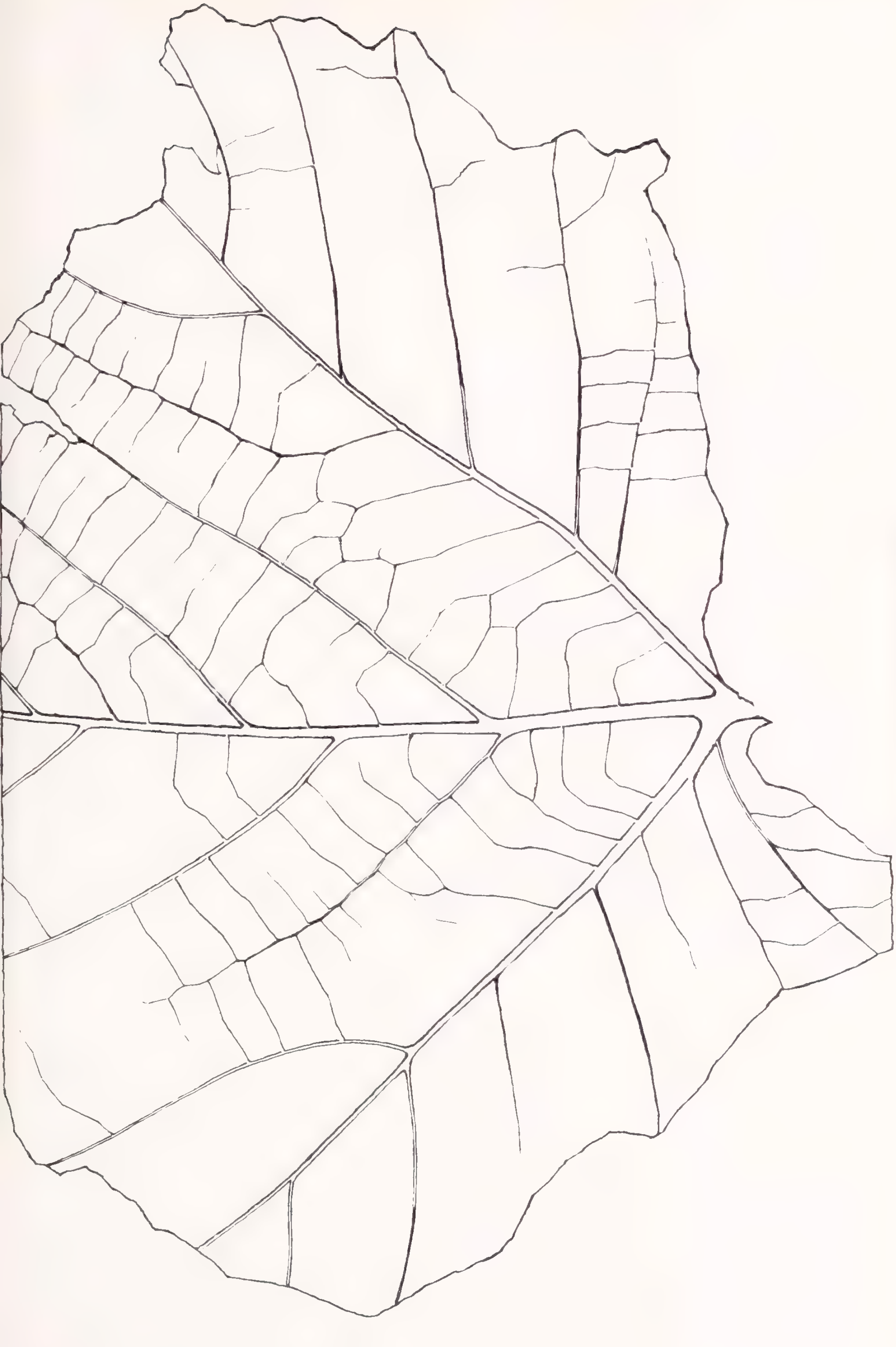
Platanus pseudoccidentalis n. sp.	409



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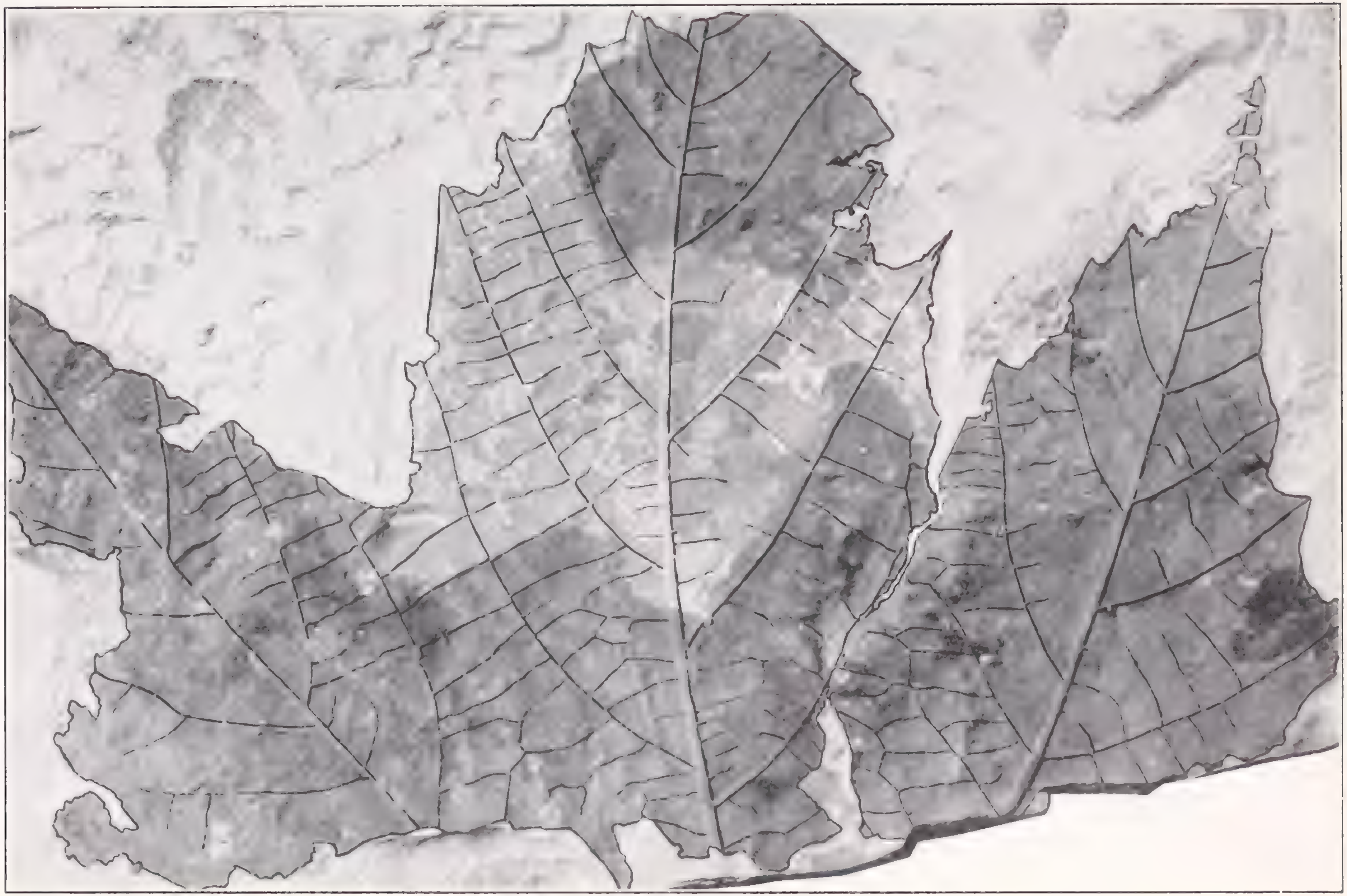
Platanus pseudoccidentalis n. sp. 409



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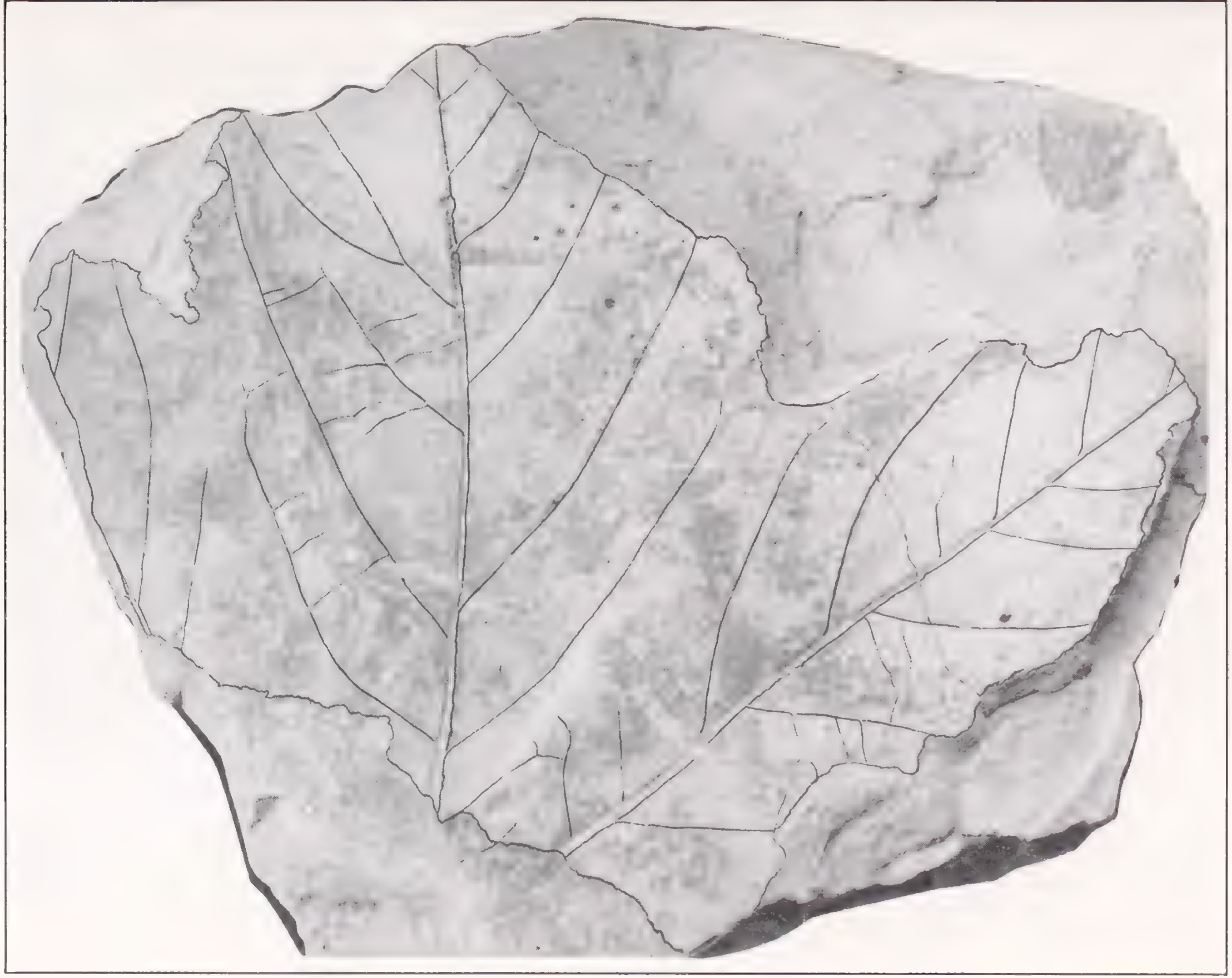
Platanus pseudoccidentalis n. sp. 409



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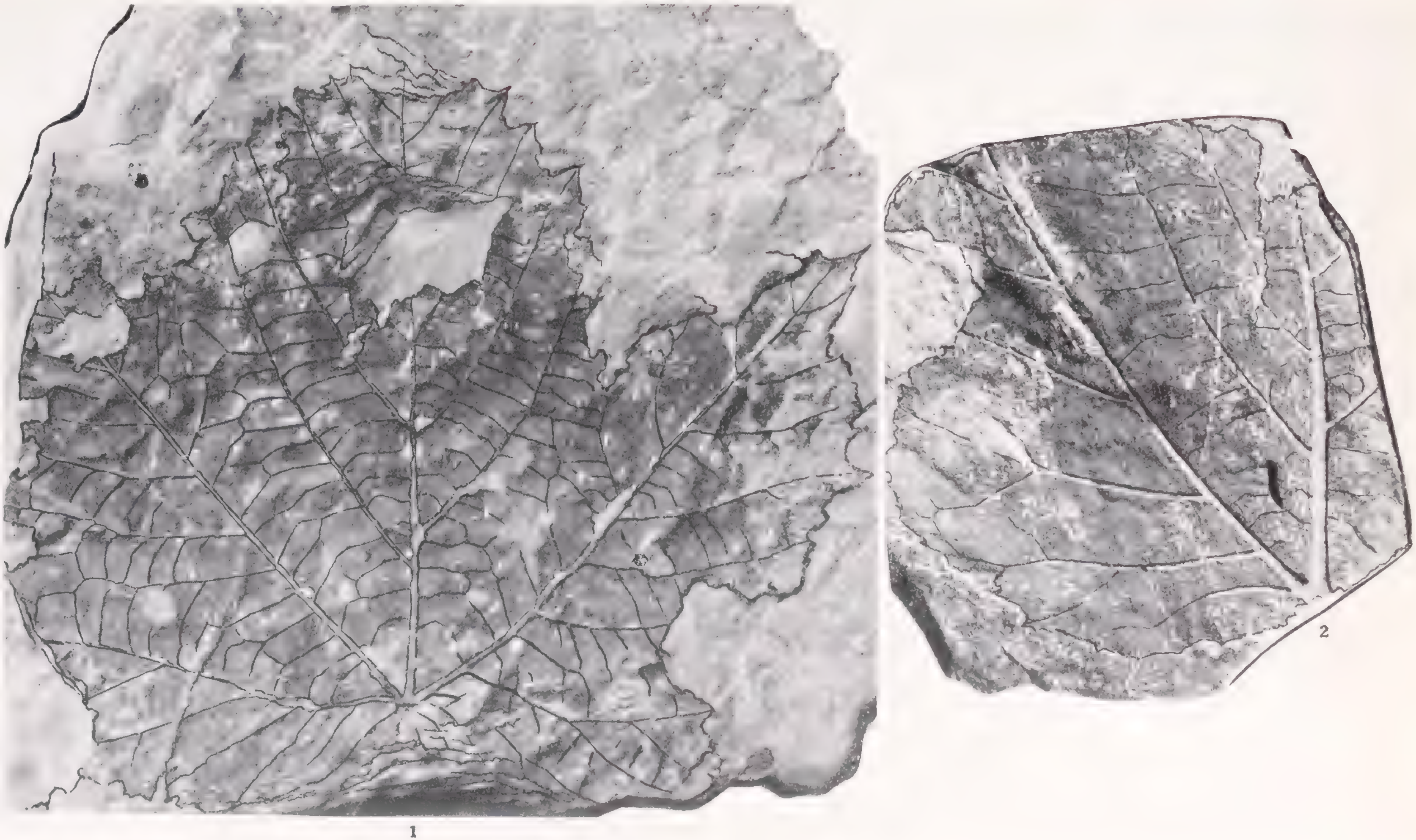

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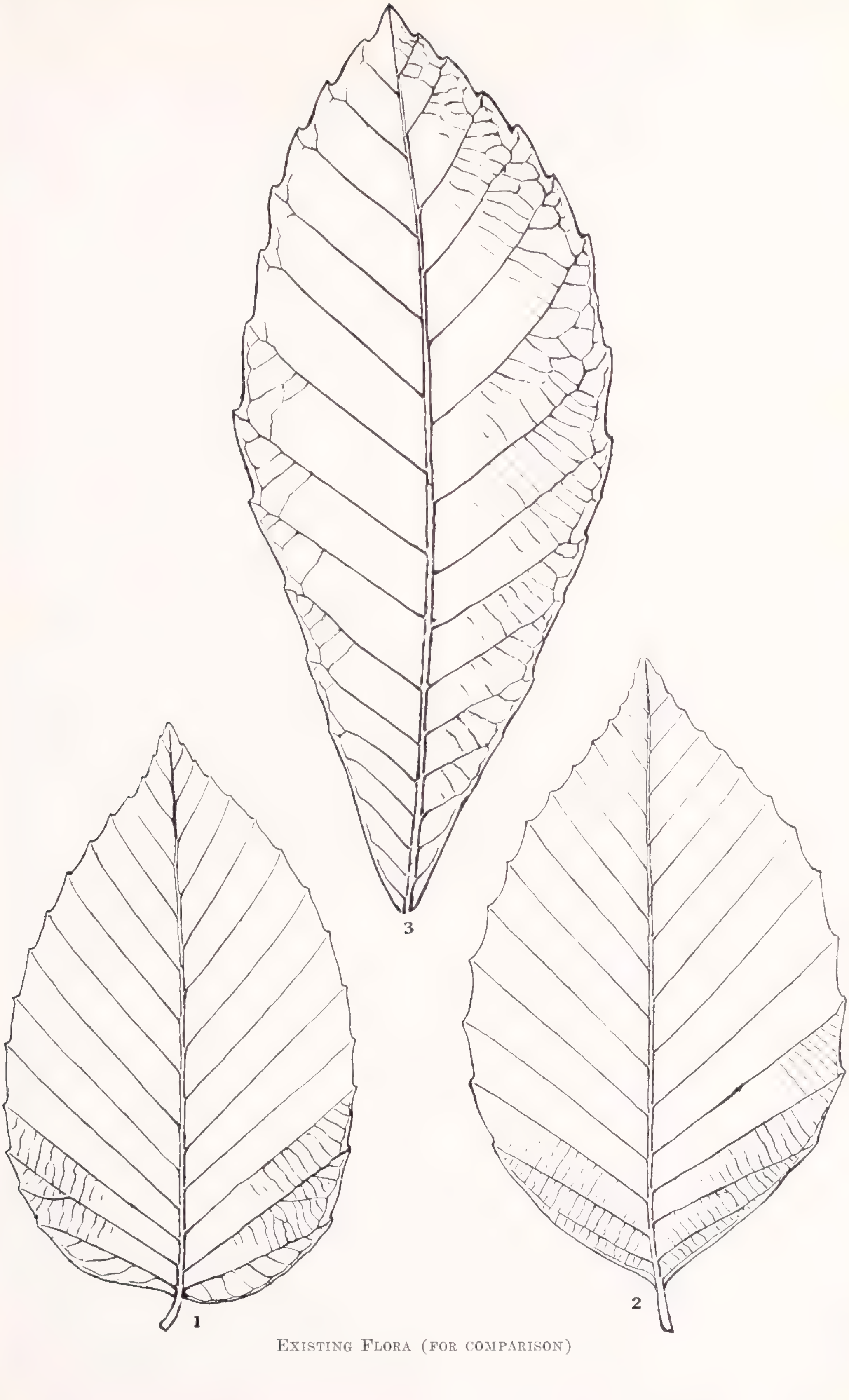

Existing Flora (for comparison)

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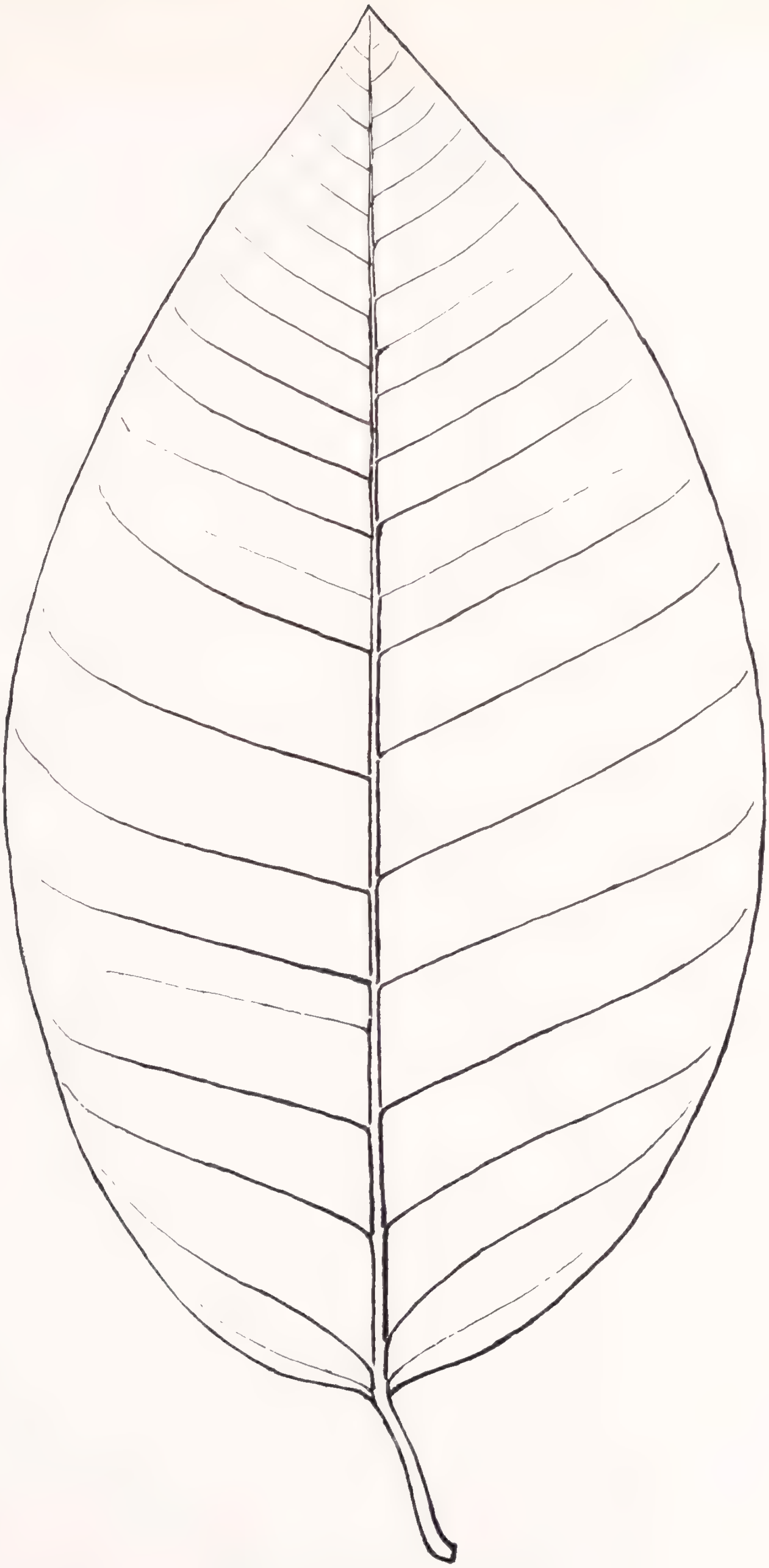
Specimen introduced for comparison

Ficus Krugiana Warburg (slightly reduced in size). Martinique. Père Duss, 1883–84, No. 1412. Specimen in Herb. New York Bot. Gard. 406



Existing Flora (for comparison)

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Specimens introduced for comparison

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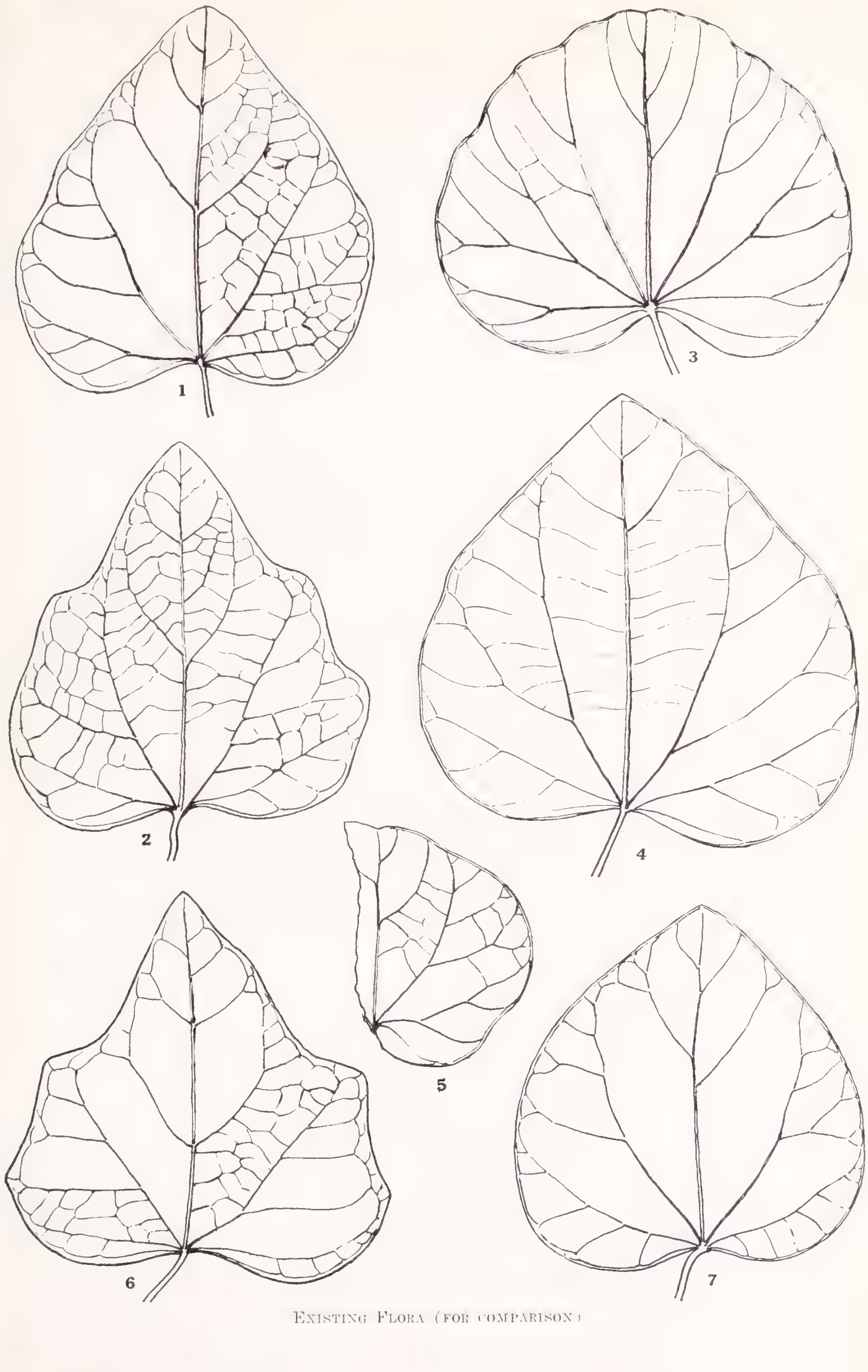
FIGURE 7. *Menispermum diversifolium* (Miquel) Prantl (= *Cocculus diversifolius* Miquel). Japan. Maximowicz, 1863. Specimen in Herb. New York Bot. Gard. 409



Existing Flora (for comparison)

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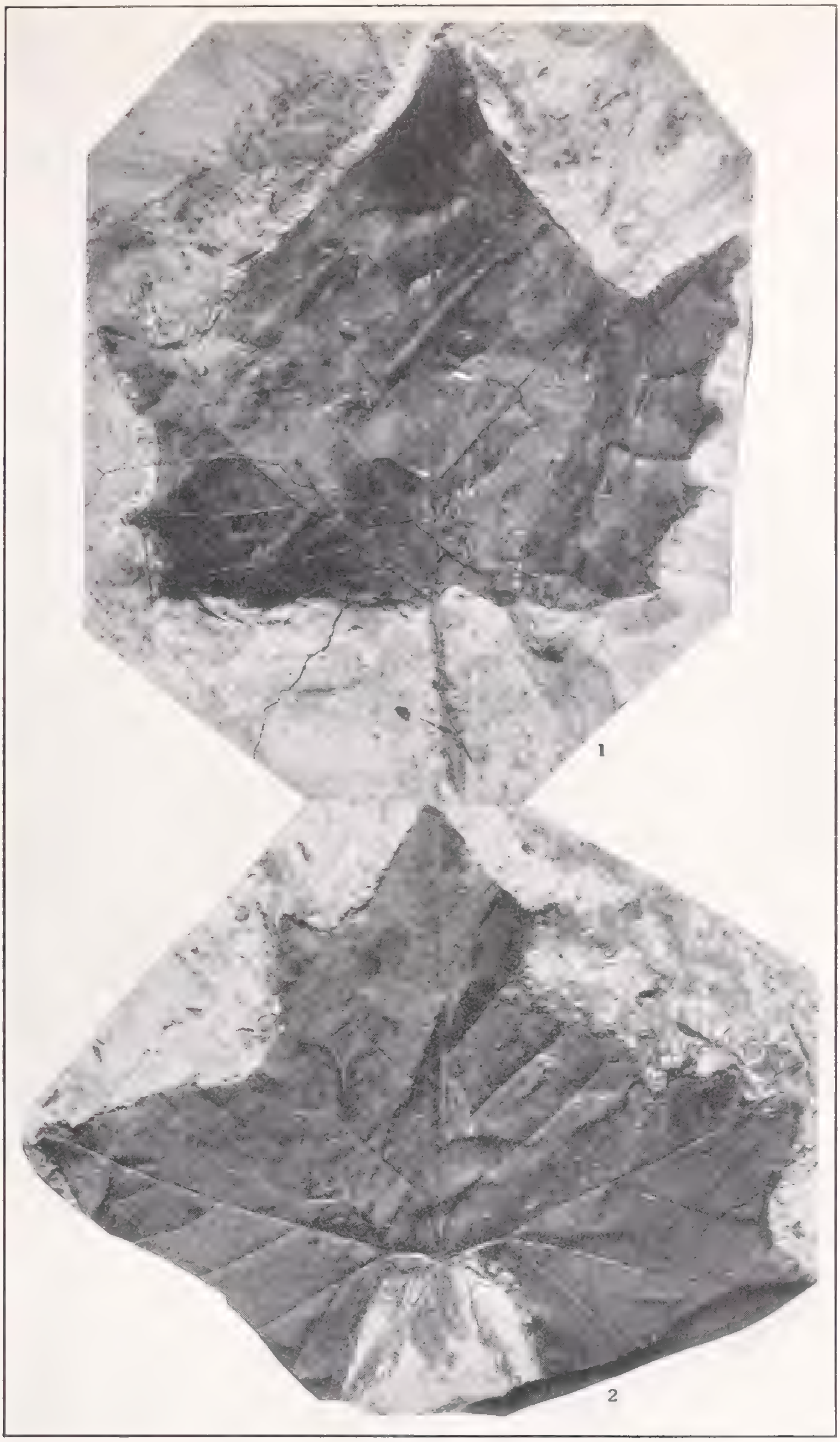
Specimens introduced for comparison

FIGURE 1. *Acer pleistocenicum* Penhallow 412
FIGURE 2. *Acer torontoniense* Penhallow 412
Type specimens. Pleistocene. Don River Valley, Toronto, Canada.



Pleistocene Flora (for comparison)

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